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**WATERSHED WORK PLAN
LAKE CREEK WATERSHED
LEWIS COUNTY, WASHINGTON**



SEPTEMBER 1969

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WATERSHED WORK PLAN

LAKE CREEK WATERSHED

Lewis County, Washington

Prepared under the Authority of the Watershed
Protection and Flood Prevention Act (Public Law
566, 83rd Congress, 68 Stat. 666), as amended.

Prepared by

Lewis County Drainage District #1

Town of Morton

Board of County Commissioners of Lewis County

Lewis County Soil and Water Conservation District

With Assistance by

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

September 1969

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WATERSHED WORK PLAN AGREEMENT

between the

LEWIS COUNTY DRAINAGE DISTRICT # 1

TOWN OF MORTON

BOARD OF COUNTY COMMISSIONERS OF LEWIS COUNTY

LEWIS COUNTY SOIL AND WATER CONSERVATION DISTRICT
(hereinafter referred to as the Sponsoring Local Organization)

State of Washington

and the

SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Lake Creek Watershed, State of Washington, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Lake Creek Watershed, State of Washington, hereinafter referred to as the watershed work plan, which plan is annexed to and made part of this agreement.

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about ten years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions and stipulations provided for in the watershed work plan:

1. Except as otherwise provided herein, the Sponsoring Local Organization will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost \$88,680). The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organ- ization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Land Rights Cost</u> (dollars)
Stream Channel Improvement	100	0	88,680
Water Control Structure	100	0	0

2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State Law as may be needed in the installation and operation of the works of improvement.
3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organ- ization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Stream Channel Improvement	0	100	208,625
Water Control Structure	0	100	32,730

4. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organ- ization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Engineering Costs</u> (dollars)
Stream Channel Improvement	0	100	22,950
Water Control Structure	0	100	3,600

5. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$2,410 and \$33,785 respectively.

6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
11. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
13. No member of, or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
14. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture

(7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

LEWIS COUNTY DRAINAGE DISTRICT #1
Local Organization

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of Lewis County Drainage District #1, adopted at a meeting held on _____.

Secretary, Local Organization

Date _____

TOWN OF MORTON
Local Organization

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Town of Morton, adopted at a meeting held on _____.

Secretary, Local Organization

Date _____

BOARD OF COUNTY COMMISSIONERS OF LEWIS CO.
Local Organization

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Board of County Commissioners of Lewis County, adopted at a meeting held on _____.

Secretary, Local Organization

Date _____

LEWIS CO. SOIL & WATER CONSERVATION DISTRICT
Local Organization

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Lewis County Soil and Water Conservation District, adopted at a meeting held on _____.

Secretary, Local Organization

Date _____

SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

By _____

State Conservationist

Date _____

WATERSHED WORK PLAN

LAKE CREEK WATERSHED Lewis County, Washington

September 1969

SUMMARY OF THE PLAN

Location and Sponsors

The Lake Creek Watershed is located in southwestern Washington and contains 7,100 acres tributary to Lake Creek, which in turn, flows into the Tilton River. It lies in Township 12 North, Ranges 4 and 5 East of the Willamette Meridian.

Several legal entities of local government are sponsors of this watershed project. They are: Lewis County Drainage District No. 1, Town of Morton, Board of County Commissioners of Lewis County, and Lewis County Soil and Water Conservation District.

Watershed Problem and Measures to be installed

This plan covers the problem of flooding due to excessive precipitation in the watershed.

The works of improvement to be installed consist of land treatment measures and structural measures. Land treatment measures to be applied are those designed to reduce sediment and to maintain or increase infiltration of precipitation into the soil. Structural measures, consisting of an improved outlet channel and a waterflow control structure, will serve to discharge excess water; will prevent flood damage from storms of a recurrence chance of more than ten in 100 years, and will substantially reduce damages from larger storms.

It is estimated that two fiscal years will be required to install the structural measures and that ten years will be required to accomplish the installation of the land treatment planned for the area.

Costs and Benefits of the Project

The project cost is estimated to be \$467,150, of which construction is expected to be \$241,355; engineering services, \$26,550; other costs such as land rights and project administration, \$124,875; and installation of land treatment measures, \$74,370. These costs will be shared between Public Law 566 funds and funds furnished by the local sponsors as follows:

The share of the project cost to be paid from P. L. 566 funds is estimated to be \$301,690, or 65 percent; and the share of the project cost to be paid by local landowners and agencies of local government is \$165,460, or 35 percent.

Benefits from the structural measures are estimated to be \$29,475 annually, at adjusted normalized prices, and the average equivalent of structural measures costs is estimated to be \$21,550; providing a ratio of benefits to costs of 1.4 to 1. It is expected that the works of improvement will reduce the average annual damage by more than 95 percent.

Project Installation, Operation, and Maintenance

Lewis County Drainage District No. 1 will be the agency of local government responsible for obtaining needed land rights. The sponsoring local organization has formally requested the Soil Conservation Service to administer all construction contracts.

DESCRIPTION OF THE WATERSHED

Physical Data

Lake Creek Watershed is the land tributary to Lake Creek in eastern Lewis County, Washington. Lake Creek is tributary to the Tilton River. A part of the town of Morton, Washington is within the watershed and the general setting is the western foothills of the Cascade Range.

Geology

The geology of the area is that of the Cascade Mountain Province. Bedrock exposed in the watershed is of Tertiary Age. It includes marine and nonmarine sedimentary rocks, together with basalt and andesite flows. Pleistocene and Recent Age alluvial sediments make up the flood plain deposits. Except for the extensive peat deposits, the flood plain sediments consist of a combination of stratified silts, clays, and sands. The depression in which the peat deposit was laid down within the flood plain owes its origin to the valley being partially dammed by glacial debris. The debris was deposited as end moraine by local glaciation.

Topography

Lake Creek Watershed lies on the western slope of the Cascade Mountains in southern Washington. The uplands consist of rugged, mountainous slopes that are drained by steep, short tributaries. Elevations within the watershed range from 875 feet at the outlet to 2400 feet at the top of the ridges.

The flood plain is broad and flat with a poorly defined drainage system at the upper end of the valley due to alluvial fans. The lower portion of the flood plain has a moderately well defined drainage pattern. The creek empties into the Tilton River just below the town of Morton, Washington.

Climate

The climate of the watershed is typical of the western Cascade region. The basin has an oceanic climate, the result of prevailing westerly air currents from the Pacific Ocean, modified by orographic influences. Variations in both temperature and precipitation result from the irregular relief. In general the area has cool summers and comparatively mild winters.

The average January temperature is 37° F., and the average July temperature is 65° F. The maximum recorded temperature was 105° F., and the minimum, minus 15° F. The average growing season for annuals is 147 days. Perennial crops, such as grasses, continue growth for nearly

280 days. Local differences in elevation make climatic data for any one locality representative of only a limited area.

Nearly all precipitation is in the form of rain, although some snow is common in winter. Average precipitation for the area is 56.86 inches per year, and nearly half of this amount is concentrated in the months of November, December, and January.

Soils

Most of the soils of this watershed have deeply weathered parent materials and heavy textures. In spite of this, the majority, even the cutover soils, have excellent structures for penetration of water, air, and roots; and in many areas, have good depth, adequate drainage, and properties making them easy to till.

The mountainous area surrounding the valley is dominated by two soil types. On the south side of the valley, Wilkeson soils predominate. Under virgin conditions, a one- or two-inch layer of partly decomposed organic duff is on the surface. Mineral surface soil, to a depth of 15-18 inches, is brown and moderately acid silt loam containing many small, soft, spherical, shotlike pellets. It is friable and feels mealy to the touch. The land on the north side of the stream (facing downstream) is dominated by an association of Olympic, Wilkeson, and Cispus soils containing a layer of gray, fine pumice that is on the surface to a depth of 4-12 inches.

Glacial activity, occurring prior to the Vashon glaciation period, deposited over most of the area a thin veneer of till, rubble, and fine soil material similar to that from which the Wilkeson soils developed. In these steep, rough areas the development of normal soils has been retarded, and the soils resemble the Wilkesons only in their broader aspects. They are usually shallower and much more stony. Bare rock outcrops are common.

There are several soil series in the valley; the most dominant of which is Nesika gravelly loam. This is a deep, well drained, gently sloping alluvial fan soil adjacent to basaltic hills. The surface soil is gritty, and often contains infrequent angular gravels and stones of basalt. The subsoil is medium to moderately fine textured and often gravelly or stony. This productive soil erodes easily and needs protection from stream overflow. A large area in the valley is underlain with postglacial and Recent Age deposits of peat. Along the margins of the peat deposit, terrace and alluvial deposits of silts, sands and clays exist.

Land Use

The pattern of land use in the watershed is dominated by forests which cover 82.8 percent of the area; cropland accounts for 13.2 percent; and miscellaneous uses, such as roads, water, town, and farmsteads, 4.0 percent.

There are 23 farms in the watershed. Only two farms contain 160 or more acres; 12 are over 40 acres; and nine are less than 40 acres in size. Forage production for the support of dairy and beef cattle is the main cropland use. This use of the land is consistent with the properties of the soils involved and nearly all the land is used within its capabilities.

The State has an eighty-acre tract on the lower slopes of the eastern part of the watershed, which has a hardwood cover with a few scattered Douglas-fir. They do not plan to log this tract in the near future. Their management objectives for this tract are consistent with State Department of Natural Resources' policy of managing lands for the greatest long-term benefit to the State.

Cover Conditions

All of the area above the valley floor is forested and has been logged. Although devastating fires burned and reburned portions of the watershed fifteen to thirty years ago, excellent fire control since then has resulted in some type of vegetative cover everywhere. The forest land consists of second growth Douglas-fir with some western hemlock and western red cedar interspersed with large areas of red alder, big leaf maple and brush species. About 60 percent of the area is covered by medium to fully stocked pole and sawtimber stands. The remainder is either in hardwood or seedling and sapling conifers mixed with hardwoods and lesser vegetation. Full conifer cover is the objective of the major timberland owners.

Water Resources

Lake Creek, approximately six miles long, and Davis Lake with a surface area of 13 acres, are the main surface water resources of the valley. Minnie and Johnson Creeks are tributaries to Lake Creek. These creeks, together with smaller unnamed streams, furnish water for livestock. Ground water for domestic use is in adequate supply at depths of 30-60 feet. The channel of Lake Creek carries the water from the area to the Tilton River, a tributary of the Cowlitz River. The Cowlitz, in turn is tributary to the Columbia River near Kelso, Washington.

Fish and Wildlife Resources

The principal fishery resource of the watershed is Davis Lake which is stocked annually by the Washington State Department of Game with 5,000 to 7,000 catchable rainbow trout and 5,000 fry cutthroat trout, when available. A small number of coho salmon and steelhead trout utilize lower Lake Creek. Anadromous fish numbers are artificially controlled by hatchery needs of the City of Tacoma's Mayfield-Mossy Rock hydro-electric project on the Cowlitz River. Additional species present in Davis Lake include bass, bullhead, and non-game species. Some sea run cutthroat trout may be present.

Access to Davis Lake is very limited, there being only one principal access at the Morton Gun Club property. The peat substrata in and around the lake, the heavy growth of brush, and a high water table make the shoreline of the lake virtually inaccessible except for the poorly developed access point on the Gun Club property. In spite of the physical access problem local people enjoy limited fishing in the lake and stream.

The watershed contains wildlife in the form of deer, beaver, fox, pheasant, and ducks. Local sportsmen have limited hunting for upland birds. A small amount of waterfowl hunting takes place for ducks that temporarily use the area. The location is poor with respect to the Pacific flyway. The dominant big game species is the blacktailed deer and the upper watershed is in one of the best deer areas of Lewis County.

Economic Data

The Lake Creek Watershed contains 7,100 acres, of which 940 acres are cropland, 400 acres farm woodland, and 5,480 acres commercial forest land. Approximately 25 acres are water and 255 acres are used for roads, farmsteads, and a portion of the town of Morton. There is no Federal land in the watershed and only 80 acres of State-owned land.

Population of the watershed is approximately 1,350 persons and most of them live in that portion of the town of Morton lying within the watershed. It is estimated that about 200 people live in the rural areas of Lake Creek Watershed.

The watershed is traversed by State Highway 7 and by a secondary surfaced road on the opposite side of the valley. The forested lands are accessible only by logging roads and foot trails.

The economy of the general area is based primarily on wood products industries. There are two sawmills and a plywood plant in Morton at the edge of the watershed and a new sawmill located within the watershed.

The source of materials for these and other mills is the forested area of the western slopes and foothills of the Cascade Mountains, of which Lake Creek Watershed is a part.

Most operators of the farm units in the valley work at least some of the time in the wood processing industries. Some of these farms are of adequate size to be economic units but flooding conditions have prevented their operation as full-time farms. Beef and milk produced on this land add considerably to the basic economy of the watershed.

The farmland is valued at from \$100 to \$500 per acre. The price of the average unit of 40 acres, with buildings, is approximately \$25,000.

Water supply is from shallow wells and is generally adequate for domestic use.

The small Davis Lake does supply some fishing for local residents but at present does not add much to the economy. The Game Department's estimate is 1,000 man-days of use on the lake and creek.

The Lewis County Soil and Water Conservation District has 14 farms under agreement within the watershed. However, due to flooding, only a small amount of planned practices, such as seeding of improved grasses and legumes, have been put into effect on the farmland.

The present economy of the area is such that many of the existing units can be rehabilitated by the operators and become family farm units again when the floodwater problem is alleviated.

WATERSHED PROBLEMS

The major watershed problem is sporadic flooding of the valley lands from excessive rain or rain and snowmelt combined. The outlet of the valley is over old glacial deposits and the present channel is unable to accommodate the flow. Sporadic flooding from Davis Lake and the channel from the lake to Temple Road prevents farmers from efficient use of committed factors of production.

Needed land treatment measures are not practical to install while the flood hazard conditions prevail. Hazard of flood damage discourages tillage necessary for re-establishment of cropland pasture. Floodwaters induce a high water table condition on much of the cropland not actually flooded.

The range in elevation between low water and the expected high water of the one percent chance event is about nine feet at Davis Lake.

When severe storms cross the watershed and the ground is near saturation from previous storms, flooding usually takes place. The land first affected is that adjacent to Davis Lake. Here a rise in water elevation of three feet will flood approximately 110 acres of agricultural land. This occurs nearly eight years out of ten. A rise in water elevation of six feet can be expected to occur in 13 out of 100 years and will inundate 700 acres with relatively still water. Another 350 acres will be affected by overland flows and high water tables.

Floodwater and Sediment Damages

Floodwater damages are caused by: (1) overland flow on the alluvial fans; (2) inundation by relatively still water on the valley floor; and (3) high water tables in areas affected by the impounded water or from overland flow or both.

There are approximately 1,100 acres in the valley subject to a combination of the above named damages. The largest proportion of this area is agricultural; however, 40 houses in Morton, the Veterans of Foreign Wars hall, and Morton High School suffer damage from the less frequent flows.

A typical flood-producing storm hit the watershed January 27-30, 1965. Following .87 inch of rain on January 26, there were 1.18 inches on the 27th, 1.91 inches on the 28th, 1.84 inches on the 29th, and 1.14 inches on the 30th. Runoff water from this storm raised the lake to a level of approximately 935 feet, USGS datum. At this elevation approximately 700 acres were flooded by still water and another 350 acres were flooded by flowing water entering the valley. Most of the water had drained out of the area by mid-February. Property damage on agricultural land was calculated to be \$565, and other agricultural damage, \$13,690. The storm was estimated to have a chance of recurring about once in eight years.

Most sediments are dropped before the water reaches the lake. Sporadic local sediment damages occur downstream from the lake.

A hazard to the public health is caused by floodwater interference with a sewage disposal outlet, and by effects on vector habitat. Conditions of flooding tend to degrade general environment in the valley.

PROJECTS OF OTHER AGENCIES

There are no authorized works of improvement for water resource development by other agencies which will be affected by the works of improvement proposed in this plan. Mayfield Dam of the Tacoma Power and Light is downstream, but the watershed project will not affect this installation.

BASIS FOR PROJECT FORMULATION

Local sponsors in their application for Federal assistance identify several damages stemming from two principal aspects of flooding:

1. Prolonged flooding, causing damage to property and croplands and inducing an excessively high water table. The present channels are adequate in depth and capacity to provide drainage for the area.

2. Need for control of the water table under various seasonal conditions to reduce subsidence of organic lands.

The objective of the sponsors is to prevent damaging floods in the watershed. Floodwaters affect cropland, woodland, and developed property, including industrial, residential, and school. A small airport, and several miles of county and private roads are seriously affected.

Sponsors request assistance in reducing floodwater and sediment damage on farmlands to allow improved management. This includes better utilization of forage, establishment of improved hay and pasture seedings, more intensive cropping, improved weed control measures, and protection of farm property.

Protection of other property and improvement of public facilities are also dependent on flood prevention. Protection of the school buildings and playground are mentioned. Damages to the sewage disposal system and environment, including discharge of untreated effluent, during periods of prolonged flooding have not been evaluated.

Improvement of outdoor recreation opportunity and general environment, including reduction of pollution hazard and other hazards to the health, enjoyment, and proper development of the area, are benefits which will be realized but are unevaluated.

The level of flood prevention considered equitable for croplands and open lands in the area is protection against floods having a probable recurrence interval of ten years or less. The urban area will be protected against the one percent flow.

Estimates of present uses and capabilities of the land in the watershed were made from records of the Lewis County Soil and Water Conservation District and from the Lewis County Soil Survey. Reports by the Lewis County Planning Division entitled "Summary of Existing Land Use for Morton, Washington," and "Economic Report for Morton, Washington," were utilized in defining objectives with local interests and for sources of basic area data.

Objectives, then, may be summarized as the selection of land treatment measures and structural measures required to reduce damages from flooding

and to allow the land to be developed within its potential. This would permit more efficient use of factors for production and a higher level of production providing increased opportunity for family farms with less dependence on off-farm employment. Other objectives are to improve health and environmental conditions and reduce excessive maintenance costs on public and private property.

Selection of Land Treatment Measures

The farmers in the area farm only the lowlands and have established land use within the capability of the soils for sustained use. The area for treatment has been considered by zones for estimation of benefits and treatment needs (page 37). Measures selected will reduce soil loss by erosion on Zone III to a maximum of three tons per acre. This is the land subject to overland flow. Sediment production on Zones II and I will be reduced concurrently. Cross slope seeding, protection from scour, and maintenance of winter cover are the principal measures to be used.

Commercial timber producers of the area manage their forest lands on a sustained yield basis and are expected to continue the presently adequate management. The greater part of the forest land is in young second-growth Douglas-fir, 30-45 years old. These dense even-aged stands will probably not be heavily cut for 20-40 years. All roads and trails have become stabilized and offer no runoff or sediment problem. Conditions of the forest economy within the foreseeable future may justify intensive forest practices for production such as thinning and salvage of wind and insect damaged merchantable timber involving commercial holdings.

Fire protection to the forest lands, both public and private, is furnished by the State Department of Natural Resources. The Department maintains a 20-man fire crew one mile north of Morton. In addition, a four-man pump truck crew is stationed at the same barracks. During fire weather conditions the project area is covered by the Department's aerial fire detection patrol. Kosmos Lookout, on the highest point of the north rim, is the principal fixed fire detection site for the watershed, which is manned only when critical fire weather conditions exist.

The Morton Fire District handles fires within the populated areas and can be called upon to assist other protection agencies if the need arises.

Selection of Structural Measures

The level of protection considered adequate for intensive forage production in this area is protection against floods having a probable recurrence interval of ten years or less on croplands. At this level of protection, both the physical and economic factors are favorable for a

substantial reduction of floodwater damage and a reduction of the hazard to public health and other environmental factors caused by floods.

Measures selected for installation are channel improvements and a water control structure. The water control structure is needed to protect the area of peat soil from subsidence due to excessive lowering of the water table. The measures selected appear to be lowest in total cost of any combination of measures that will achieve project objectives and are compatible with the development potential of the land.

Upland storage for flood prevention does not appear practical because of lack of storage sites. The principal structural alternative considered was a wide, shallow floodway to provide control of subsidence of organic lands. A narrow, more efficient channel, with structural control included is less expensive and is selected.

The size and location of structural works of improvement were determined by engineering studies. The degree of protection selected on the basis of hydraulic and hydrologic characteristics of the watershed and the expected future economy of the area is protection against the ten percent chance of occurrence flood. Flows up to one percent will cause quiet inundations of lowlands with little property damage, and provide no unusual hazards to life or public health. Overbank flows will be of short duration and of infrequent occurrence.

Water table control for the peat soils will be achieved by a water control structure located in the improved outlet channel near Temple Road. The control structure will control the water elevation in Davis Lake to 929 feet USGS datum or to the elevation that provides the most desired level of operation. There is usually enough inflow to Davis Lake to more than offset evaporation losses. Side channels to intercept overland floods will be installed. The water control structure is designed to allow the required flows to be discharged by the channel in wet weather without undue drawdown of the water table in the peat during dry periods.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Land treatment measures considered necessary to maintain or improve the present hydrologic condition of the major portion of the watershed are included in this plan. Land treatment measures include only those which contribute to project objectives. These are adequate for grass-land forage production.

Cropland includes all arable land used for production. There are 940 acres of cropland in the watershed, used primarily for production of forage for livestock. Land in forage production is normally used for close grown grain in rotation about one year in ten.

Measures expected to be installed alone or in combination are as follows: Conservation cropping systems (600 acres), seeding grasses and legumes (400 acres), pasture and hayland planting (200 acres), pasture renovation (300 acres), woodland seedings (150 acres), and drainage mains and laterals (10,000 feet). Fire prevention and wildlife habitat preservation will be considered on all lands. Sponsors will work closely with the Lewis County Planning Commission to advise on conservation measures needed on any lands to be platted for residential housing.

The uplands of the watershed, for the most part are in young, vigorous forest regrowth. There are 150 acres of slash burned area that will be planted to trees within the next two years. The Department of Natural Resources checks each logged area to insure compliance with the State of Washington Forest Practices Act for restocking all clearcut areas within five years after logging.

Soil surveys are completed on agricultural lands, and no additional technical time is required for this purpose.

Structural Measures

The town of Morton is expected to construct 400 feet of outlet channel at non-project cost to convey waters originating in Morton to a project channel.

Improved Channel

In the main channel of Lake Creek 17,200 feet will be enlarged to convey a flow of 910 c.f.s. at the upper end and a flow of 1,620 c.f.s. at the lower end of the valley. The beginning bottom width will be ten feet, and the width at the lower end will be approximately 22 feet.

Seven tributary channels will be improved to convey flood flows from the edge of the valley to Lake Creek. Approximately 235 thousand cubic yards of excavation and 56 acres of land clearing will be required to complete this part of the project. These channels enter the main channel on non-erosive gradient and no appurtenances are considered necessary for the outlets of these channels or on the tile outlets. Locations and details of these channels can be found in the drawings attached to this plan.

Short reaches of riprap are proposed for the Minnie, L. Allen and Bingaman channels to prevent meander. Bottom stability of these channels is believed adequate. Additional riprap is indicated for the lower reaches of the main (Lake Creek) channel. This is intended to protect the State highway located adjacent to the stream.

Spoil banks which remain adjacent to the channels shall be smoothed adequately to provide access for maintenance purposes.

The location for wasting excavated materials must be accepted as to practicality by the Service. Such wasted materials shall be used preferably for filling oxbows or undrained portions of channels within the right-of-way. Spoils may also be piled in shaped trapezoidal embankments parallel to the channel within the right-of-way, or spread in a thin layer on the surface of the ground within the right-of-way where the adjacent land is in agricultural use.

Spreading and smoothing in lieu of other methods of spoil disposal shall be to the extent required to permit efficient hydraulic functioning of the channel and to facilitate reasonable agricultural use of adjacent lands, but such operations shall not extend beyond 300 feet in any direction from the point of excavation unless spreading beyond 300 feet is determined by the Service to be less costly to the government than other alternative practical options of disposal. Spreading of poorly graded sands, gravels or other non-agricultural soils materials shall not be considered practical unless requested by the local organization.

When it is not practical to spread or otherwise dispose of excavated material by hauling or spreading as described above, it shall be piled or shaped into spoils banks located on rights-of-way adjacent to the excavation but separated by a berm distance designated by the Service. In no case shall excavated material block the valley channel required for conveyance of the 1 percent flow. Waste banks shall be provided with pipes or channels or be interrupted to provide water disposal and prevent erosion. Spoil banks shall be shaped to facilitate weed control and other maintenance. After placement, the responsibility for maintenance and/or the further disposition of the material in the spoil banks is a non-project cost.

The degree of smoothing accomplished at project construction cost will be that reasonably attainable by heavy construction equipment and with consideration of the type and condition of the material to be spread.

An estimated ten culverts will be required for field access; plus culverts on two ditches to convey floodwaters under the railroad. The county bridge on Temple Road and two farm bridges are to be replaced. Foundation material for the county road bridge is basalt and both farm bridges will be on mineral soil.

Water Control Structure

A water control structure will be located in the main channel below Davis Lake, near Temple Road. The purpose of this structure is to permit the control and regulation of the water elevation of Davis Lake and the ditches which enter the lake. This is an area of peat soil and water control is necessary to prevent unwanted and unnecessary subsidence. It is expected that the structure will be constructed of reinforced concrete set on a natural rock foundation. It will have two radial gates. Either or both may be automatically controlled. Weirs will be provided on each side of the gates which may be regulated by stop logs. These weirs will provide emergency overflow if the gates should fail to operate properly. They will also provide low flow regulation which will be difficult to obtain from the radial gates. A partial concrete top is provided for stability and to facilitate operation and maintenance. The water control structure is an appurtenance of the channel improvement and is necessary to obtain the flood prevention benefits as a mitigation feature to prevent excessive induced subsidence of organic lands.

EXPLANATION OF INSTALLATION COSTS

Land Treatment Costs

Estimated costs of installing land treatment measures are summarized in table 1. Farm costs are based on Agricultural Stabilization and Conservation Program records and local experience of the Soil Conservation Service. The cost to install land treatment measures represents the cost of actually applying these practices on the land, including ACP cost sharing where applicable. The costs are estimated expenditures of district co-operators and others in performing the work and in purchasing materials needed.

Technical assistance to apply these measures will be furnished by the Soil Conservation Service and others cooperating with the Lewis County Soil and Water Conservation District. These costs include salaries and associated costs of technicians who will assist owners and operators in the application of the measures. These costs are estimated to be \$290 annually, or a total of \$2,900 during the installation period, for carrying on the going program of the Lewis County Soil and Water Conservation District. In addition, for private and state lands, the Department of Natural Resources provides technical assistance and inspects logged areas

for compliance with the State Forest Practices Act at an estimated cost of \$750. These going rates of technical assistance are deemed sufficient to meet the needs of the watershed and no P.L. 566 funds will be needed for accelerating the installation of land treatment measures. For installing land treatment measures, district cooperators and other local interests will pay an estimated total of \$74,370 (including \$23,070 for practices on forested lands) during the project installation period.

Structural Measures Costs

The estimated costs of installing structural measures, including construction, engineering services, project administration, and other (land, easements, and rights-of-way), are shown in tables 1 and 2.

Construction Cost

The construction cost is based on engineering estimates of quantities required to provide project structures in accordance with current engineering standards. These quantities, multiplied by the unit construction costs applicable for this area and increased by a contingency factor of 15 percent, become the total estimated construction cost of \$241,355.

The estimated construction cost includes the cost of culverts needed for conveying floodwaters under the railroad. Also included is the cost of placing, smoothing, or hauling excavated materials not needed for construction within the permanent right-of-way, or contiguous right-of-way obtained by temporary land rights; or, alternatively, the hauling and placing of such excavated materials in contiguous oxbows or undrained parts of channels created by construction within such rights-of-way. The purpose is to conform to local custom for similar work and permit maintenance and reasonable agricultural use.

Engineering Services

Engineering services includes direct costs for surveys, investigations, design, and preparation of plans and specifications for structural measures. Engineering costs to be paid from P.L. 566 funds are estimated at \$26,550, or 11 percent of the estimated construction cost.

Project Administration

This includes additional costs associated with the installation of structural measures, including contract administration and necessary inspection services during construction. The P.L. 566 share of these costs is estimated at \$33,785, or about 14 percent of the construction cost. The non-P.L. 566 share of project administration is estimated at \$2,410.

Other Structural Measures Costs

This item (table 1) includes the following costs required to be paid from other than P.L. 566 funds:

The entire cost of acquiring land rights, or water rights, for project purposes. This item includes all elements of construction, administration, engineering, and legal services associated with acquiring such rights, including removal or salvage of buildings and improvements or changes to telephone, power, gas, water, and sewer lines or other utilities but not including group drainage or irrigation facilities. Land required is that needed for the construction and occupancy of project structural measures, for the operation and maintenance of such measures, and for flowage easements along the channel or elsewhere that may be needed under conditions of operation that may induce changes in duration or elevation of the lake or channel flows. The general location of these lands is shown on the preliminary plans. Rights-of-way costs include channel crossings, bridges, or other auxiliary improvements to the channel or lakeshore lands. These estimated costs are broken down as follows:

a. Acquisition of land rights	\$52,825
b. Land cost, legal and survey fees	6,425
c. County bridge at Temple Road	15,320
d. Farm bridges	5,000
e. Culverts (estimated 10 culverts, plus 400 feet of 12-inch conduit)	<u>9,110</u>
	\$88,680

Cost Allocation

All structures included in this work plan are for the single purpose of flood prevention and all structural measures costs are allocated to the flood prevention purpose.

Cost Sharing

The total cost of all project measures is estimated at \$467,150. Of this, P.L. 566 funds will bear approximately \$301,690, or 65 percent, and other funds will provide about \$165,460, or 35 percent.

The following costs will be borne from P.L. 566 funds:

1. The total construction cost of the channels for the single purpose of floodwater disposal, estimated at \$208,625.
2. The estimated sum of \$32,730 for construction of the floodwater control structure.
3. Engineering costs for surveys, design, etc., \$26,550.
4. Project administration costs of \$33,785.

The following costs will be borne by other than P. L. 566 funds:

1. The cost of technical assistance required for maintaining the present rate of planning and application of land treatment measures, estimated to be \$2,900, from regular appropriations of the Soil Conservation Service.

2. The cost of installing land treatment measures on watershed lands, estimated to be \$48,400 on cropland and \$23,070 on woodland, or a total of \$74,370. This includes assistance, such as ACP, that may be available from other Federal or State programs.

3. An estimated \$88,680 for acquiring land rights.

4. Costs associated with project administration estimated at \$2,410.

Installation of project measures will be over a ten-year period, with the work of installing structural measures in the first two years following execution of the construction agreement, and the installation of land treatment measures continuing through the ten-year period.

The following schedule shows the anticipated rate of expenditure of funds by fiscal years:

Schedule of Expenditure of Funds

<u>Fiscal Year</u>	<u>Structural Measures</u>		<u>Land Treatment</u>		<u>Total</u>
	<u>P.L. 566</u> <u>Funds</u>	<u>: Other</u> <u>Funds</u>	<u>P.L. 566</u> <u>Funds</u>	<u>: Other</u> <u>Funds</u>	
First	24,135	64,250	0	9,300	97,685
Second	277,555	26,840	0	9,300	313,695
Third	0	0	0	6,195	6,195
Fourth	0	0	0	6,195	6,195
Fifth	0	0	0	6,195	6,195
Remaining	<u>0</u>	<u>0</u>	<u>0</u>	<u>37,185</u>	<u>37,185</u>
Total	301,680	91,090	0	74,370	467,150

EFFECTS OF WORKS OF IMPROVEMENT

Land Treatment Measures

The assistance provided through the Cooperative Forest Management Act as administered by the Department of Natural Resources encourages the forest owners to restock recent cutover areas. This program will keep the uplands of the watershed in excellent hydrologic condition with good productive potential.

The installation of measures on the lowlands will increase the efficiency of production factors by taking advantage of the improved conditions resulting from structural measures. Stability of family farms will be enhanced by this increase in efficiency of production factors. Improved grass cover on the land will reduce sediment to the channels. Reduction of ponded waters will improve vector control.

Structural Measures

The effect of the channel improvement and the water control structure will be to prevent the high water levels now attained on the lowlands. The channel will provide improved conveyance for abnormally high floodwaters to be discharged into the Tilton River. The effect will be to reduce floodwater damages on 940 acres of cropland, and 450 acres of non-cropland, including some urban areas, which presently flood for prolonged periods after a major storm. Damage is expected to be of greatly reduced intensity. The average damage reduction effected for all storms of more than one percent chance of occurrence is more than 95 percent. The control structure is to prevent excessive subsidence of organic lands upstream from the structure.

Structural measures will make possible the prevention of damages from flooding in the town of Morton. The town will construct 400 feet of conduit to convey waters originating in the town to a project ditch.

Effect of Structural Measures on Fish and Wildlife Habitat

Davis Lake is unsuited for spawning, but is stocked with approximately 5,000 trout annually by the Washington State Game Department. The improved channel below the control structure is expected to have exposed gravels on the bottom suitable for use as spawning areas for such anadromous fish as successfully get past the Mayfield Dam about 50 miles downstream. Reduction of flooding will enhance nesting areas for upland birds and will improve hunting area for local sportsmen.

PROJECT BENEFITS

Benefits to be expected from the project are: (1) approximately 95 percent reduction in average annual floodwater damage from storms occurring more frequently than one percent of the years; (2) increased income to agricultural land as a result of removal of floodwater hazard.

Average annual primary damages that were evaluated total \$18,060 at adjusted normalized prices. The structural works of improvement will reduce these damages by \$17,580, leaving residual average annual damage of \$480 at adjusted normalized prices (tables 5 and 6).

Benefits from more intensive land use will accrue to agricultural lands relieved of long periods of inundation. This will make possible better farming practices on this land and will result in benefits of \$10,265 annually at adjusted normalized prices.

Secondary benefits locally are computed at \$1,830 but are not needed for project justification. Secondary benefits from the national viewpoint are not considered pertinent to the project.

COMPARISON OF BENEFITS AND COSTS

The annual equivalent benefits expected to result from structural works of improvement total \$29,475. The equivalent average annual cost of structural measures, including operation and maintenance, will be \$21,550 (tables 4 and 6). This relationship of benefits to costs provides a ratio of 1.4 to 1. Ratio of benefits to cost without secondary benefits is 1.3 to 1.

PROJECT INSTALLATION

This plan will be carried out as a joint undertaking of non-Federal sponsors and the Federal government. Non-Federal interests include individual landowners and operators, Lewis County Soil and Water Conservation District, Town of Morton, Lewis County Drainage District No. 1, and Lewis County. These sponsoring local organizations have formally requested the Soil Conservation Service to administer all project construction contracts.

Lewis County Drainage District No. 1 is designated by sponsoring local organizations as their agent, and will represent the several non-Federal interests during project installation. It will acquire the necessary lands, easements, and rights-of-way by exercise of the right of eminent domain, if necessary, and provide the non-Federal share of the installation costs of structural measures.

The Lewis County Soil and Water Conservation District, organized under State law, is empowered to enter into agreements and contracts,

to sue and be sued, to carry out soil and water conservation operations, and to apply soil conservation treatment through cooperator-district agreements within the boundaries of the district. The Lewis County Soil and Water Conservation District will continue the going program of the district within the watershed at the rate which existed prior to the development of this work plan. It will execute agreements with owners of private lands for installation of land treatment measures.

The Town of Morton will provide, at non-project cost, a conduit to convey floodwaters originating in the town into the project ditch and otherwise assist in project installation.

All sponsors will cooperate with State or Federal agencies concerned with the project. The principal participating agency of the Federal government will be the Soil Conservation Service of the United States Department of Agriculture.

Reasonable care will be taken during construction to prevent blockage of anadromous fish during the spawning runs.

The necessary land rights for the structural measures will be acquired by the sponsors before Federal assistance is made available for construction of any structural measures in the project. Flowage easements or rights to land in the possession of any sponsor will be made available to the sponsoring organization accepting responsibility for the construction and the operation and maintenance of the structural measures.

Responsibilities of other local organizations and Federal agencies participating in this work plan are given below:

Lewis County, through the Lewis County Board of Commissioners, will provide and maintain a portion of the rights-of-way in the form of necessary easements, roads and bridges over the improved channel of Lake Creek and tributaries, and will maintain such other county-owned property as is significant to the project.

The Forest Service exercises general administrative supervision and competency over forested portions of the watershed. The Forest Service will maintain liaison with the sponsors and assist in appropriate revisions of this work plan. The going rate of supervision and assistance on these lands will be continued.

The Farmers Home Administration, under provisions of P. L. 566, administers credit and loan provisions of the Act. The Administrator will give high priority to requests for credit assistance in carrying out structural parts of this work plan.

The Agricultural Stabilization and Conservation Committee of the State and County administer ACP incentive funds in the area. The

agency is expected to give high priority in scheduling ACP funds to expedite the land treatment required by this work plan.

The Washington State Department of Water Resources is the agency designated by the Governor to take leadership in coordinating State agency assistance to watershed projects. The agency will give priority to this watershed and will consult with the sponsors and assist technically and financially on behalf of the State government to the extent practical.

The Washington State Department of Natural Resources manages State-owned forest lands within the watershed, provides technical forestry assistance in the project area, and has primary responsibility for protecting the forest area from fire damage.

Rural Community Development Service - Agencies participating in the Rural Community Development Service program (formerly RADP) will have enlarged opportunities after this watershed project is installed for assisting farmers and rural dwellers in making full use of land, water, and timber resources for agricultural, recreational and industrial development. These agencies will be called upon by the sponsors, as feasible, for technical assistance and capital for the purpose of achieving more efficient agricultural operations, training unemployed, establishing rural industries and businesses and providing public facilities for health, transportation, recreation and general welfare. This assistance is expected to be furnished by practical rescheduling of going programs of the agencies involved.

Installation of Land Treatment Measures

Land treatment measures will be installed over the project period of ten years by individual land owners with technical assistance provided by the Soil Conservation Service and the State Department of Natural Resources in cooperation with the Lewis County Soil and Water Conservation District. The Department of Natural Resources provides technical assistance on 5,480 acres of forest land owned by industry and 400 acres of forest land in small woodland ownership. The annual quantities outlined in the following table are felt to be realistic and are consistent with the historical rate of planning in the watershed. No funds for accelerated technical assistance are being requested due to the adequacy of the present program. The annual increments in the table are average annual estimates and are not meant to be construed as conservation operations goals.

Land Treatment Measures	:	Quantities to be installed, by Years					
		: Unit	: First : Year	: Second : Year	: Third : Year	: Fourth : Year	: Fifth : Year
<u>CROPLAND</u>							
Cons.Cropping Sys.	ac.	60	60	60	60	60	300
Grasses & Legumes in Rotation	ac.	40	40	40	40	40	200
Pasture & Hayland Planting	ac.	20	20	20	20	20	100
Pasture & Hayland Renovation	ac.	30	30	30	30	30	150
Tile Drains	lin. ft.	2000	2000	2000	2000	2000	10000
<u>WOODLAND</u>							
Tree Planting	ac.	85	85	10	10	10	0
Thinning	ac.	15	15	15	15	15	25

To provide technical assistance during the project period for the installation of land treatment measures, the estimated sum of \$2,900 will be used by the Soil Conservation Service in its regular program of assistance to the Lewis County Soil and Water Conservation District in the watershed area.

Installation of Structural Measures

Project structural measures will be installed during a two-year period. Construction work will proceed concurrently on both the water-flow control structure and the channel improvement. Lewis County Drainage District No. 1, representing the sponsors, has formally requested the Soil Conservation Service to serve as the contracting agency. Effort will be made to complete the work in one construction season. This usually involves two fiscal years as work must be done in the comparatively dry summer months.

FINANCING PROJECT INSTALLATION

As the organization responsible for installation and maintenance of the project, Lewis County Drainage District No. 1 has the power under State law to plan, install, and maintain improvements for drainage, protection from overflow, and similar beneficial purposes. Costs converted into assessments are levied against benefited lands; and money necessary to meet the costs of installation can be secured by borrowing, issuing

warrants, or bonds secured by these assessments. The District may exercise the right of eminent domain for necessary purposes and may sue and be sued in the Superior Court of the County.

Land treatment measures installed on private property are the responsibility of the individual landowners but the cost may be met in part under existing law by the USDA Agricultural Conservation Program and through credit facilities of the Farmers Home Administration.

The Soil Conservation Service will contribute all of the construction cost for the single purpose flood control measures; plus engineering services and other services for project administration, including project construction contracts. The total estimated cost to be paid for the installation of structural measures from P. L. 566 funds is estimated to be \$301,690.

The local sponsoring organization will acquire the land rights prior to construction. The estimated cost of rights-of-way, including bridge replacement or modification, relocation of utilities, etc., is \$88,680. In addition, the local organization is responsible for non-Federal costs associated with project administration. This cost is estimated to be \$2,410. This is within the capacity of the local sponsoring organization to accomplish.

The local sponsors are aware that financial and other assistance to be provided by the Soil Conservation Service is conditioned on the fulfillment of the local obligations presented in this plan and contingent upon Congressional appropriation of the required funds.

It is not expected the sponsors will request loan funds under provisions of P. L. 566.

PROVISION FOR OPERATION AND MAINTENANCE

Operation and maintenance of land treatment measures will be the responsibility of the individual owners of the properties on which the measures are installed. Technical assistance is available from the Lewis County Soil and Water Conservation District, with assistance from the Soil Conservation Service.

The operation and maintenance of the waterflow control structure and channels will be by the Lewis County Drainage District No. 1, at an estimated annual cost of \$3,185 (adjusted normalized price). This maintenance estimate includes allowances for control of vegetation, sediment, cleanout and repair.

Specific maintenance agreements will be executed prior to the issuance of invitations to bid for any construction contract.

The sponsors, and the Soil Conservation Service employee responsible for operation and maintenance inspections and followup, will jointly make an inspection annually, after unusually severe floods, and after the occurrence of any other unusual conditions that might adversely affect the structural measures. These inspections will continue for three years following installation of each structure. Inspections after the third year will be made annually by the sponsors.

Land treatment accomplishments will be reviewed annually and needed actions taken to provide technical assistance to encourage continued and timely progress toward completion of this phase of the project.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Lake Creek Watershed, Washington

Installation Cost Item	:	:	:	Estimated Cost (Dollars) 1/		
				Non-Federal Land		
				P.L. 566	Other	Total
(1)	(2)	(3)	(4)	(5)	(6)	
<u>LAND TREATMENT</u>						
Soil Conservation Service						
Cropland	ac.	940		48,400		48,400
Tech. Assistance				2,900		2,900
SCS Subtotal		940		51,300		51,300
Forest Service						
Tree Planting	ac.	150 (large owners)		7,500		7,500
Tree Planting	ac.	50 (small owners)		2,000		2,000
Thinning	ac.	100 (small owners)		4,000		4,000
Tech. Assistance	ac.	5,880		750		750
Fire Protection	ac.	5,880		8,820		8,820
FS Subtotal				23,070		23,070
TOTAL LAND TREATMENT				74,370		74,370
<u>STRUCTURAL MEASURES</u>						
<u>Construction</u>						
Soil Conservation Service						
Stream Channel Improv.	ft.	39,000	208,625			208,625
Water Control Structure	no.	2/ 1	32,730			32,730
Subtotal - Constr.			241,355			241,355
<u>Engineering Services</u>						
Soil Conservation Service			26,550			26,550
Subtotal - Engr.			26,550			26,550
<u>Project Administration</u>						
Soil Conservation Service						
Construction Inspection			12,070			12,070
Other			21,715	2,410		24,125
Subtotal - Admin.			33,785	2,410		36,195
<u>Other Costs</u>						
Land Rights				88,680		88,680
Subtotal - Other				88,680		88,680
TOTAL STRUCTURAL MEASURES				301,690	91,090	392,780
TOTAL PROJECT INSTALLATION				301,690	146,140	447,830
SUMMARY						
Subtotal SCS			301,690	142,390		444,080
Subtotal FS				23,070		23,070
TOTAL PROJECT				301,690	165,460	467,150

1/ Price base, 1968.

2/ Flood prevention appurtenance.

Date September 1969

Table 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of Work Plan preparation)

Lake Creek Watershed, Lewis County, Washington

Measures	:	Unit	:	Applied	:	Total	
	:		:	to date	:	Cost	<u>1/</u>
(1)	:	(2)	:	(3)	:	(Dollars)	(4)

LAND TREATMENT

Cropland							
Conser. Cropping System		ac.		200		200	
Pasture Management		ac.		60		720	
Pasture Renovation		ac.		60		1,500	
Drainage Mains &							
Laterals		ft.		14,350		21,525	
Spoilbank Spreading		ft.		28,590		2,860	
Woodland <u>2/</u>		ac.		0		0	
<u>STRUCTURAL MEASURES</u> <u>3/</u>				0		0	

TOTAL	26,805
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1/ Price base, 1968.

2/ No estimate available.

3/ All structural measures installed at
least 10 years prior to the Work Plan.

Date September 1969

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Lake Creek Watershed, Washington

(Dollars) 1/

Structure : Site No. : or Name : (1)	Installation Cost P.L. 566 Funds :			Installation Cost - Other Funds :			Total : Install. : Cost : (9)
	(2)	(3)	(4)	(5)	(6)	(7)	
Channel Improvement	208,625	22,950	231,575	0	0	2/ 88,680	88,680 320,255
Water Control Structure <u>3/</u>	32,730	3,600	36,330	0	0	0	0 36,330
Subtotal	241,355	26,550	267,905	0	0	88,680	88,680 365,585
Project Admin.	xxxx	xxxx	33,785	xxxx	xxxx	xxxx	2,410 36,195
GRAND TOTAL	241,355	26,550	301,690	0	0	88,680	91,090 392,780

1/ Price base, 1968.

2/ Included in this figure is \$6,425 for legal fees and survey costs.

3/ Flood prevention appurtenance.

Date September 1969

TABLE 3 - STRUCTURE DATA

CHANNELS

Lake Creek Watershed, Washington

Channel Designation	Station Numbering for Reach		Water-shed Area (sq.mi.)	Planned Channel Capacity 10% Freq. (cfs)	Hydraulic Gradient (ft/ft)	Average Bottom Width (ft.)	Average Depth (ft.)	Average Side Slope	Velocity		Volume of Excavation (1,000 cu.yds.)
	Sta. (2)	Sta. (3)							50% Peak Frequency Aged (10)	As Built (11)	
Lake Creek	130+58	145+00	3.6	910	0.00416	10	6.7	1.5:1	6.0	6.4	
Lake Creek	145+00	159+50	4.1	960	0.00245	10	7.8	1.5:1	5.0	5.4	
Lake Creek	159+50	190+94	4.8	1,060	0.00245	12	7.8	1.5:1	5.1	5.4	
Lake Creek	190+94	194+00	8.0	1,425	0.00245	20	7.5	1.5:1	5.2	5.5	31
Davis Lake											
Lake Creek	226+00	315+00	9.5	1,550	0.000854	22	9.9	1.5:1	3.7	4.0	
Lake Creek	315+00	320+00	10.8	1,620	0.005	22	6.4	1.5:1	7.1	7.8	
Lake Creek	320+00	334+75	11.1	1,620	0.0143	20	5.0	1.5:1	10.5	11.3	145
Williams	0+00	16+50	.25	200	0.00184	4	5.0	1.5:1	3.0	3.3	
Williams	16+50	36+00	.5	300	0.00308	6	4.9	1.5:1	4.2	4.5	11
Ecklund	0+00	10+00	.1	100	0.0016	4	3.8	1.5:1	2.5	2.8	2
Spiller	0+00	31+00	.4	250	0.00167	4	5.7	1.5:1	3.1	3.4	9
School	4+00	30+25	.1	100	0.0023	4	3.4	1.5:1	2.9	3.1	6
Minnie	0+00	15+00	.5	300	0.0093	8	3.4	1.5:1	6.1	6.5	
Minnie	15+00	30+30	1.7	600	0.0043	8	5.4	1.5:1	5.6	5.8	12
L. Allen	0+00	3+50	.7	360	0.00286	8	5.0	1.5:1	4.2	4.5	
L. Allen	3+50	10+50	.7	360	0.00857	8	3.8	1.5:1	6.3	6.6	
L. Allen	10+50	24+00	.7	360	0.00207	8	5.4	1.5:1	3.8	3.9	8
Bingaman	0+00	5+50	.25	200	0.0382	6	2.1	1.5:1	8.8	9.7	
Bingaman	5+50	9+50	.25	200	0.0275	4	2.6	1.5:1	7.7	8.3	
Bingaman	9+50	16+50	.25	200	0.00714	4	3.7	1.5:1	4.9	5.2	
Bingaman	16+50	29+25	.25	200	0.00236	4	4.7	1.5:1	3.2	3.4	5

1/ Values used for "n": aged, 0.035; as built, 0.032.

2/ All channels are being enlarged for flood capacity.

Date September 1969

TABLE 4 - ANNUAL COST

Lake Creek Watershed, Washington

(Dollars) 1/

Evaluation Unit	: Amortization of Installation Cost	<u>2/</u>	: Operation and Maintenance Cost	: Total
(1)	(2)		(3)	(4)

Structural Measures

Channel and Water Control Structure	16,675		3,185	19,860
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Project Administration	1,690	xxxxx	1,690
TOTAL	18,365	3,185	21,550

1/ Price base: Installation 1968 prices; O&M adjusted normalized price.

2/ Amortized at 4-5/8 percent, 100 years.

Date September 1969

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Lake Creek Watershed, Washington

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without	With	
	Project	Project	
(1)	(2)	(3)	(4)
Floodwater			
Crop and Pasture	5,840	300	5,540
Property	255	20	235
Schools	6,235	<u>2/ 0</u>	6,235
Flood Fighting (Schools)	270	<u>2/ 0</u>	270
Residences	2,950	<u>2/ 0</u>	2,950
Roads and Streets	400	<u>2/ 0</u>	400
Airport	150	<u>2/ 0</u>	150
Subtotal	16,100	320	15,780
Sediment			
Cleanup of debris	250	100	150
Subtotal	250	100	150
Erosion			
Streambank	70	20	50
Subtotal	70	20	50
Indirect	1,640	40	1,600
TOTAL	18,060	480	17,580

1/ Price base adjusted normalized.

2/ Damages and benefits will accrue from floods of greater magnitude than the 3 percent frequency but were not evaluated.

Date September 1969

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Lake Creek Watershed, Washington

(Dollars)

Evaluation Unit (1)	Average Annual Benefits 1/					
	Flood Prevention					
	Damage :	More :			Average :	Benefit
	Reduction 2/ :	Intensive :	Second- :	Total :	Annual :	Cost
	tion 2/ :	Land Use :	ary :	Benefits :	Cost 3/ :	Ratio
	(2)	(3)	(4)	(5)	(6)	(7)

Structural Measures

Channel and Water Control Structure	17,380	10,265	1,830	29,475	19,860	1.5 : 1
---	--------	--------	-------	--------	--------	---------

Project Administration	xxxxx	xxxxx	xxxxx	xxxxx	1,690	xxxxx
GRAND TOTAL	17,380	10,265	1,830	29,475	21,550	1.4 : 1

1/ Benefits at 1968 adjusted normalized prices.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$200 annually.

3/ Costs at 1968 prices.

Date September 1969

INVESTIGATIONS AND ANALYSES

Project Formulation

Project objectives of the local sponsoring organizations determined the extent of the investigations and analyses necessary to the comprehensive planning of Lake Creek Watershed.

The objectives of the sponsors include the reduction or elimination of floodwater damages to pastures and school facilities in the valley.

Investigations were made to determine the land treatment and structural measures needed to accomplish these objectives at the lowest total overall cost.

Investigations for Land Treatment

An investigation of land treatment needs of the watershed was made as the first increment of project formulation. This investigation consisted of an examination of records of the Lewis County Soil and Water Conservation District; also, records of the Agricultural Stabilization and Conservation Service were utilized to determine the existing rates of progress on land treatment measures needed in the area. Field observations were made and consultations were held with soil conservation district supervisors and farmers in the area. Soils surveys of the area were studied and the land treatment program for the watershed was developed.

Investigations for Structural Measures

It became obvious that structural measures, in addition to land treatment measures, would be needed to accomplish the objectives of the sponsors. Therefore investigations were carried out to determine comparative advantages of alternatives. Alternatives were designed and used to assemble information on which to base judgment for size, location, and feasibility of structural measures to be included in the plan.

Engineering Investigations

It was apparent early that detailed studies of Lake Creek and tributary streams would be necessary. Field parties of engineers obtained data on elevations, gradients, cross sections, etc. on which to make judgments as to placement of the improved outlet channel for most effective removal of floodwaters. This also included investigations necessary to determine the placement of the waterflow control structure to achieve maximum effectiveness.

Geologic reconnaissance was carried out to determine soil stability for channel construction. The foundation for the water control

structure is basaltic rock. A few hundred feet of peat soils are located upstream and downstream from the lake. The remainder of the channels are located in stable mineral soil.

Hydrologic investigations were carried out to determine water quantities expected and the amounts necessary to be disposed of to relieve the floodwater damage. The channel and waterflow control structure were then designed to accommodate the expected flows.

Field surveys were made to provide horizontal and vertical control and to describe topographic and cultural features. These ground surveys supplemented aerial photography of the problem area. Cross-section surveys were made of existing channels and of the proposed alignment of the channel to be improved. Cross sections were typically taken at intervals of 300-500 feet and cover a width of up to 500 feet. More extensive topography was taken near the location of the proposed structure. Surveys and field data gathered were used in estimating the rights-of-way costs, and in estimating quantities used in figuring construction costs.

The primary basis for determining structural measures included in this work plan was to provide the maximum level of flood protection within the limits of sound economic and engineering practices. Costs of various alternatives in design were considered without regard to the Federal and non-Federal shares of the cost.

Consideration has been given to alternate channel locations and to alternate locations of the waterflow control structures, as well as to various types of channel design to provide the required protection from floodwaters.

Hydrology Investigations

Hydrologic soils groups were derived from Soil Conservation Service soil surveys of Lewis County and from special surveys made for this work plan. Soil cover types were determined by field trips through the watershed and by consultation with the local Soil Conservation Service technicians.

Weather Bureau stations in the area were examined and daily rainfall data were abstracted and plotted for two stations. Records of the Randall Station (elevation 946 feet, mean sea level) date back to 1926 but there are several breaks in continuity of these data. Three of these breaks are of two years duration. The Kosmos Station (elevation 775 feet, m.s.l.) has an almost perfect record dating back to 1932. The Kosmos Station is only seven miles from Morton and the Lake Creek Watershed, while Randall is 19 miles away. The elevation of

Morton is 950 feet, so either station is satisfactory from an elevation standpoint. Both stations produced similar rainfall frequency curves. The Randall Station showed the greatest variation and a resultant slightly steeper rainfall frequency curve. The Kosmos Station was finally chosen for rainfall data due to its location, its better record, and its similarity to the Lake Creek Watershed.

Nearly all precipitation is in the form of rain, although some snow is common in winter. Snow may remain on the watershed for periods of weeks but such occurrences are rare as most snow melts within a week. The average precipitation for the area is 56.86 inches per year. Precipitation is distributed as follows:

January	7.88	July	0.98
February	5.61	August	1.54
March	5.67	September	2.92
April	4.02	October	5.00
May	3.03	November	8.30
June	2.62	December	9.29

Field data were collected on a number of flood occurrences to determine the extent of flooding. The large flood which occurred during the winter of 1964-65 was selected as the flood of record; however, information on floods in other years was lacking. Since data were insufficient to use the historical method, it was decided to use the frequency method of analysis.

Rainfall data, the extent of flooding, and runoff information, along with the design flood frequency curve for Lake Creek, determined that a flood such as the flood of 1964-65 would occur thirteen times in 100 years. This frequency of flooding was used in preparation of stage-frequency and damage-frequency curves for the economic analysis of the watershed.

Times of concentration were estimated, using several alternate procedures. These were evaluated, and the velocity of channel flow by the hydraulic computation method was accepted. Hydrographs were developed for several frequencies, using precipitation amounts from the Kosmos Station, and procedures described in chapters 5, 6, 7, 9, 10, 15, and 16 of section 4, National Engineering Handbook of the Soil Conservation Service.

A concordant flow study was made, using neighboring streams for comparison. The West Fork of the Tilton River near Morton and the Tilton River near Cinebar produced values which were somewhat higher than those used on the Lake Creek Watershed, while Cinebar Creek near Cinebar produced lesser values. The elevation of Cinebar is about the same as that of Morton, and the Tilton River streams drain areas of higher elevations. The correlation between the streams is considered satisfactory and synthetic hydrograph values developed for Lake Creek are believed to be correct.

Geology Investigations

A large proportion of the Lake Creek valley is underlain with post-glacial and Recent Age deposits of peat. These deposits formed as a result of the valley being dammed by glacial debris. Davis Lake lies approximately in the center of the peat deposit area. Along the margins of the peat deposit, terrace and alluvial deposits of silts, sands, and clays exist.

Geologic investigations were carried out to determine the thickness of overburden over basalt-type rock at the centerline of the proposed structure site and to determine the quantity of rock excavation required for channel construction. Rock soundings were made at intervals for about 3,000 feet along the present stream course.

Deposits encountered in the Lake Creek valley were largely peats. Other materials found were silty clays and fine grained sands.

Investigations showed that about four feet of peaty material overlies basalt rock at the location of the structure site. This location would be suitable for construction of the structure.

Rock excavation for channel construction would begin at about station 252+50 and continue for a distance of about 1,800 feet downstream.

Economic Investigations and Analyses

During the field interviews with farmers in the Lake Creek Watershed, it developed that many of the present holders of land in the area had been in the valley for long periods of time. It was estimated that in 1940 there were 20 full-time dairy farms in operation. The demand for workers in the timber industry during World War II, coupled with flooding problems, caused many of the dairies to close. The dairymen went to work in the timber industry and converted the livestock to beef-type herds. Another large factor in the decrease in dairies was the lack of a road over White Pass. This road was completed in 1953 and the price of imported alfalfa hay was reduced by several dollars per ton.

Flood problems worsened with less than normal maintenance during the decade of the forties. In 1951, an attempt was made to rehabilitate the Lake Creek channel, but financial difficulties were encountered before they were able to lower the channel to the proposed grade, and only a widening and cleaning of the channel was completed. The continuing problem has resulted in the communities asking for assistance in planning the watershed as a P. L. 566 project.

At the present time there are 23 farms in the valley. Two farms contain 160 or more acres; 12 are over 40 acres and nine are less than 40 acres in size. One (50-cow) full-time dairy unit and one full-time beef unit are presently in operation. Land is now being acquired by one part-time operator to enable a shift to full-time operation. Other part-time operators have from 10-30 head of cattle as a part-time enterprise to supplement an off-farm job in the lumber industry.

In evaluating the impact of structural measures which will reduce floodwater damage and allow a more intensive use of land, both Senate Document 97 and The Economics Guide of the SCS Watershed Handbook assume a continued need for products customarily grown or produced in the watershed. No surplus crops are produced. In keeping with this evaluation, it appears that the area benefited will be farmed in a manner in keeping with modern technology and that farmers will choose the optimum use of land for the production of products for which markets are known to exist.

In Western Washington the major use of land is for the production of forage to support a livestock industry. Largely the forage is used to support a dairy enterprise but beef production is on the increase in the area. In the Lake Creek Watershed the present use of forage is largely for production of beef on part-time farms.

To evaluate floodwater damage to the forage production enterprise on the farms it is necessary to set a unit of measurement which is constant, relative to its use whether for beef or dairy production. For this purpose we have selected a unit called the "Calculated Nutritional Unit or CNU". A Calculated Nutritional Unit is defined as one-twelfth (1/12) of the yearly requirement of digestible nutrients fed in a balanced ration to a 1,000 pound beef cow, including the requirement to nurse and feed the calf to eight months of age at a weight of 475 pounds. The value of the CNU is determined as the lowest prevailing cost of equivalent feed. In the case of the Lake Creek Watershed area it was found that most winter feed was purchased locally and the adjusted normalized price of hay (\$22.00 per ton) was used as a base for the value of a CNU.

The entire cropland area of the valley is devoted to the production of forage for livestock. Some grain is used as a nurse crop for re-establishment of grass but is usually harvested early as forage. The present yield level varies by zone of flooding. The more frequently flooded lands producing the lower yields. Zone 1, the lowest area, yields approximately 4 CNU's per acre; Zone 2 yield is 7 CNU's; and Zone 3 yield is 9 CNU's when flood free.

After a preliminary investigation of the area, it was decided the frequency method of damage appraisal would be used and that the

basis of damages would be a duration-damage relationship rather than a peak discharge-damage relationship.

Peak flow-frequency curves were developed (see Hydrology Investigations). A stage-area flooded and a stage-volume curve were developed from field survey data. Frequency-area flooded duration relationships were developed from information obtained from the local people and from a field survey data of storage volume, area flooded, and rainfall-runoff information. Three zones of flooding are delineated which fit naturally into the topography of the valley. These are:

Zone I - is the low area adjacent to the lake and other lowlying land. Frequency of flooding is high and the duration is long for large storms. Considerable areas of peat are found in this zone. Beaver dams and other channel obstructions cause outflow to be restricted and subject to wide variation. Duration of flooding over this area varies. However, the information obtained from local farmers and other residents, as well as Soil Conservation Service observations, agreed rather well and are used to construct a flood-duration curve.

Zone II - is the intermediate area between the high fringes and the bottom areas of Zone I. This area contains the large water storage volume. Outflow from this zone is moderate to slow and the reservoir storage is large.

Zone III - is the highest area where flooding consists of overbank streamflow and the higher fringes of the valley floor which may be inundated. Duration of Zone III flooding is the length of the storm, plus the short period of overland flood flows that may follow.

A random sample damage survey covering approximately 10 percent of the area in the flood plain was made to determine the type and extent of damages from flooding in the 1964-65 season. Due to the similarity of other coastal watersheds, this is deemed to be a sufficient sample. Six of the 23 farmers in the area were contacted. This flood was determined to be a 13 percent frequency from the stage-frequency curve. The point of incipient damage was found to be 930 feet, United States Geological Survey mean sea level datum.

Reported damages to pastures and property were converted to monetary values and summarized in tabular form. This value was then expanded to represent the total area.

Information obtained from the sample fit the three zones of damage. The lower zone (Zone I) is primarily the area of peat soils and contains about 241 acres (87 acres cropland) around Davis Lake and on both sides of Lake Creek downstream. Zone II is the area of Carbondale muck, Wapato, and associated soils. This area contains approximately 766 acres

of land (534 acres cropland) subject to intermittent inundation for periods of ten days or more. Zone III consists of 621 acres (319 acres cropland) and is the area above the 935-foot contour. Parts of this area are subject to overflow by moving water for the duration of a storm. This zone is seldom flooded in excess of five days. Some erosion damage takes place in this area, usually on slopes in excess of three percent.

Estimates of percent of floodwater damage to pastures from floods of various durations were made. From this information, crop, property, sediment, and erosion damages by various durations of flooding were computed and a table was prepared showing acres flooded by stage and duration. These values were then placed on a damage-frequency curve and the area planimetered to derive the annual equivalent damage. These damages were found to be: cropland, \$5,840; property, \$255; sediment, \$250; and erosion, \$70.

Indirect damages were computed to be 10 percent of the direct primary damages.

The amortization rate used was $4\frac{5}{8}$ percent for a 100-year period of evaluation.

More intensive agricultural land use was evaluated by preparing "before" and "after" crop budgets to reflect "with project" and "without project" differences. This average difference, after netting out associated costs, was determined to be \$15.20 per acre in Zone I and \$16.75 per acre in Zone II, at adjusted normalized prices, and credited as a benefit to the project. This benefit amounts to \$10,265 annually. No additional intensive land use is expected in Zone III.

Damages to the Morton High School were determined to be in direct relation to the flood stage. Damages occur whenever water gets into the "crawl space" under the building and moisture gets to joists and flooring, causing buckling and rot. This condition exists once a stage of 934 feet is reached or exceeded. When this stage occurs it is necessary for the school to rent pumps and hire a watchman to guard against damage. This cost was estimated to be \$270 above annual average cost. At stages of 935 feet, available pumps are unable to maintain equilibrium in the crawl space and water can reach the floor joists. The consensus of the school administrator and the maintenance supervisor is that existing conditions due to floodwaters are reducing the expected life of the building by 30 percent.

The school district expects to build a \$500,000 elementary school adjacent to the high school in the near future. The same conditions are expected to prevail for the new building as for the high school and future damages to the proposed building have been discounted for

five years for lag in accrual. The annual equivalent damage expected from floodwater damage to the schools is estimated to be \$6,235. In addition \$270 must be added to the above figure as an annual cost of floodfighting.

Damages to residences in a four block area and to the VFW Hall were evaluated by a representative sample of the area. A similar situation to that of the school was found to pertain although the floodwater originates from a tributary source. Evaluation was made on the basis of accelerated deterioration due to the floodwater damage. The average annual damage is computed to be \$2,950. To correct the situation the town of Morton will install 400 feet of closed conduit to convey waters from the town into the project ditch. The cost of the conduit has been treated as an associate cost and subtracted from benefits.

Damage from floodwater to roads and streets in the town of Morton were estimated by two city councilmen at \$400 annually. This damage is caused by a minor tributary of Lake Creek and will be eliminated by project structural measures.

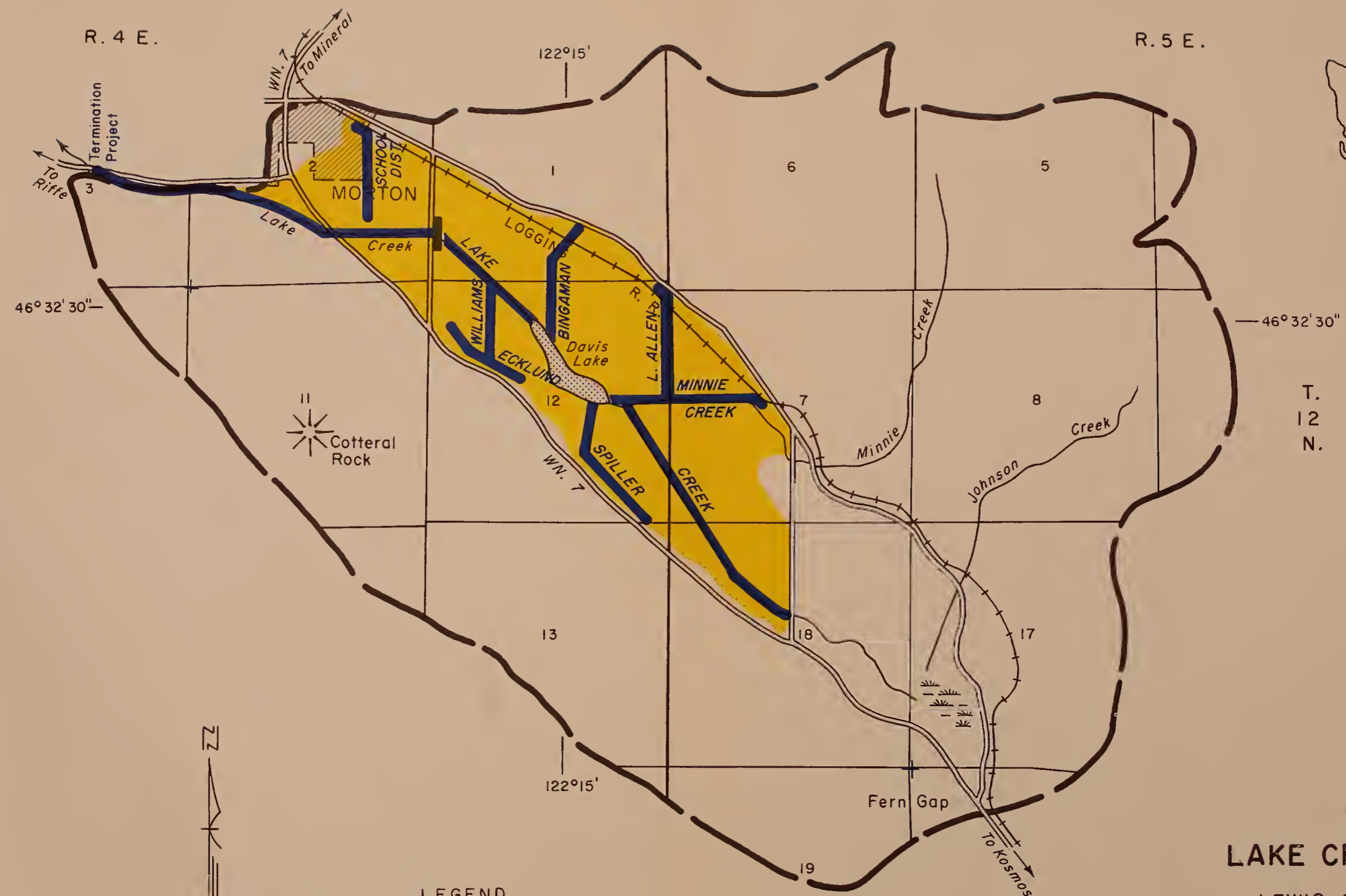
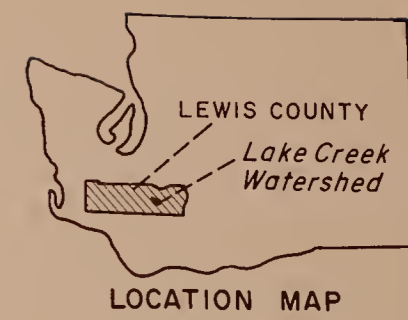
Damage to the airport consists of flooding of the runway and damage to a six-unit hangar. Whenever floodwaters rise to about 933 feet the planes must be removed from the hangars and hauled to high ground. Estimate of damage by the airport manager was \$150 annually.

Indirect damages were computed to be \$1,640 annually or ten percent of the direct identifiable damage.

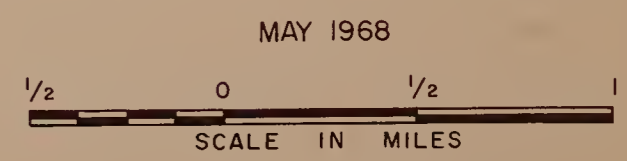
The present average annual net income to agriculture in the area is estimated at \$38,800. In the absence of the proposed project the net income is expected to remain about as it is now. With the project installed the net income to farms in the valley is expected to increase to \$55,200.

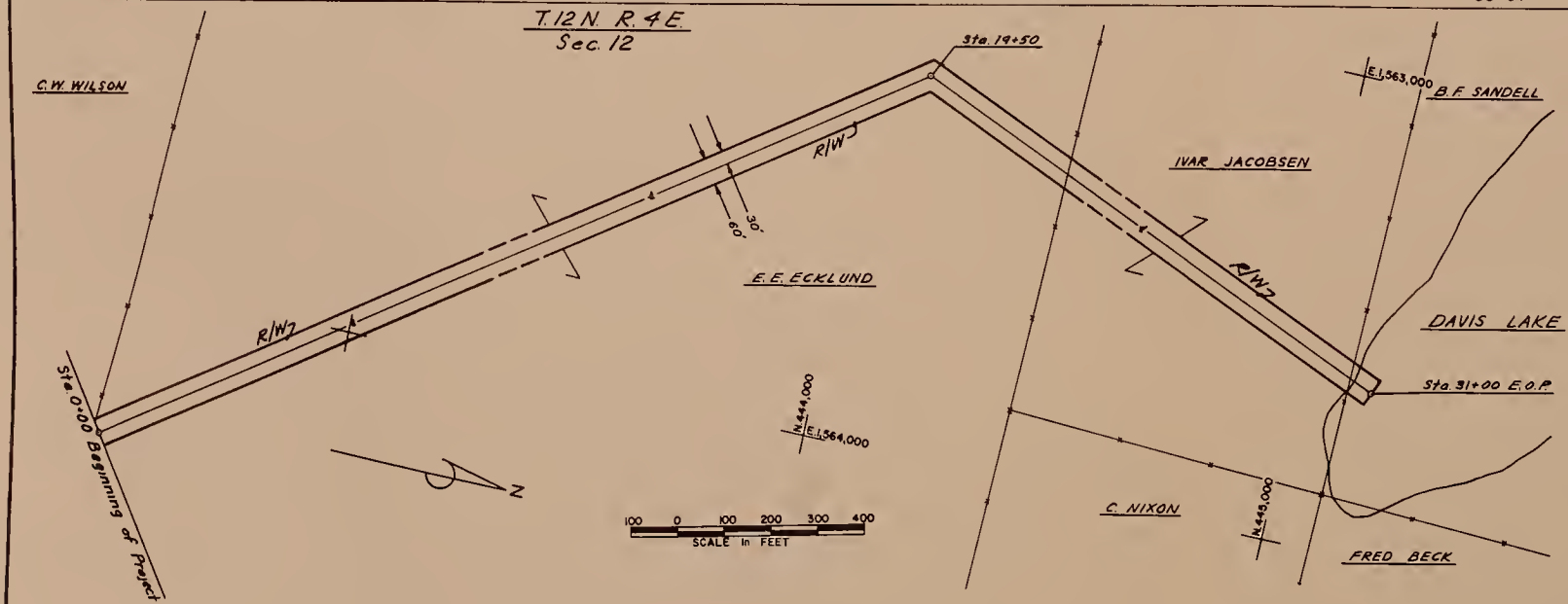
Fish and Wildlife Investigations

The Fish and Wildlife Service's reconnaissance report of October 5, 1966, concurred in by the Washington State Department of Fisheries and Game, comments favorably on the Lake Creek Watershed project and states that no further studies of the wildlife resources in the project are necessary. It suggest close cooperation with the Washington Department of Game in developing the final project features to minimize possible damage to wildlife resources.



PROJECT MAP
LAKE CREEK WATERSHED
LEWIS COUNTY, WASHINGTON





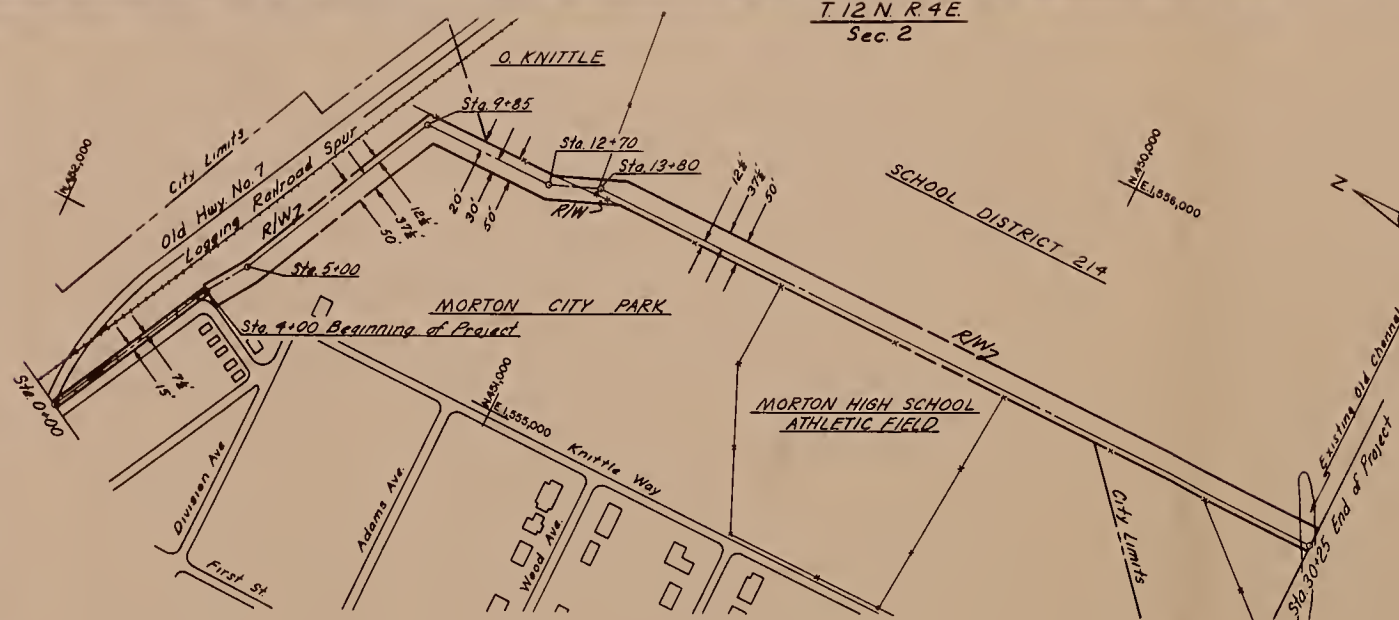
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PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
SPILLER CHANNEL

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CHECKED BY: J.N.	SHEET OF SHEET
APPROVED: E.L.N.	



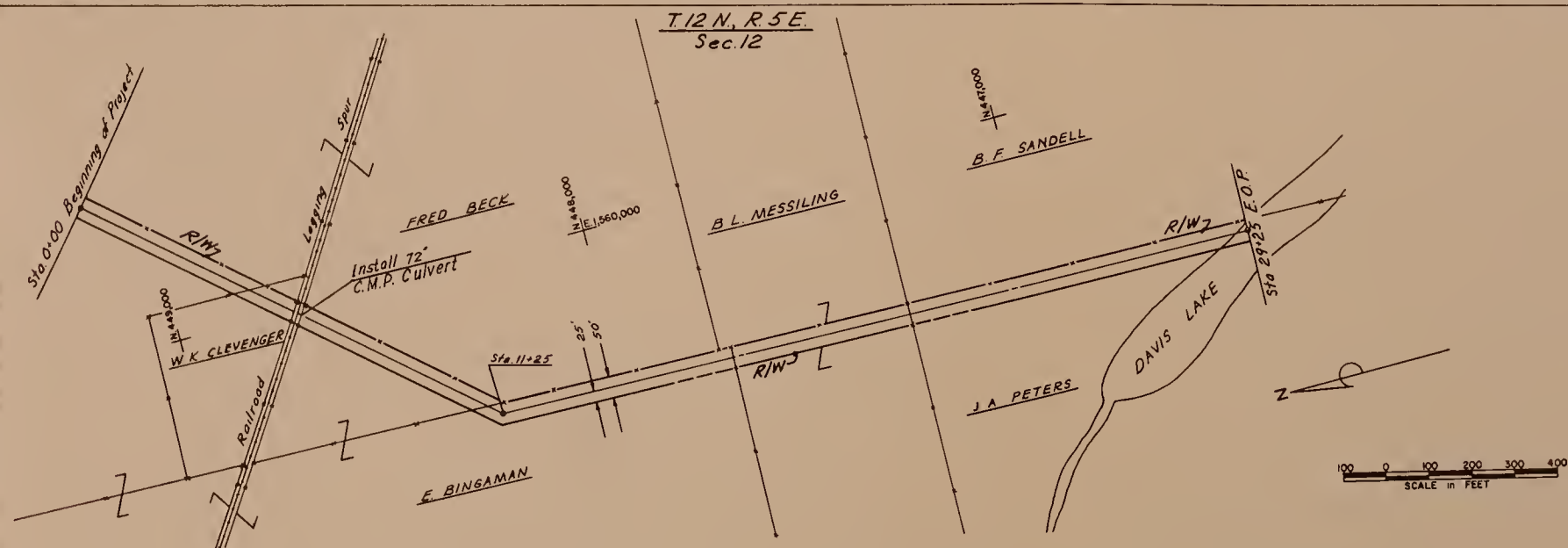
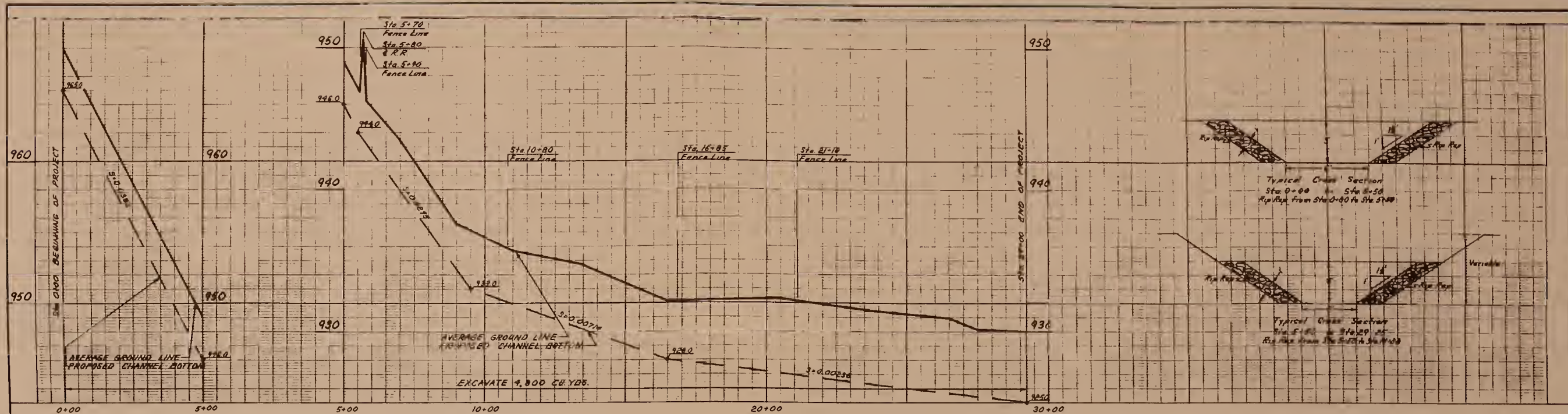
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PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
SCHOOL DISTRICT CHANNEL

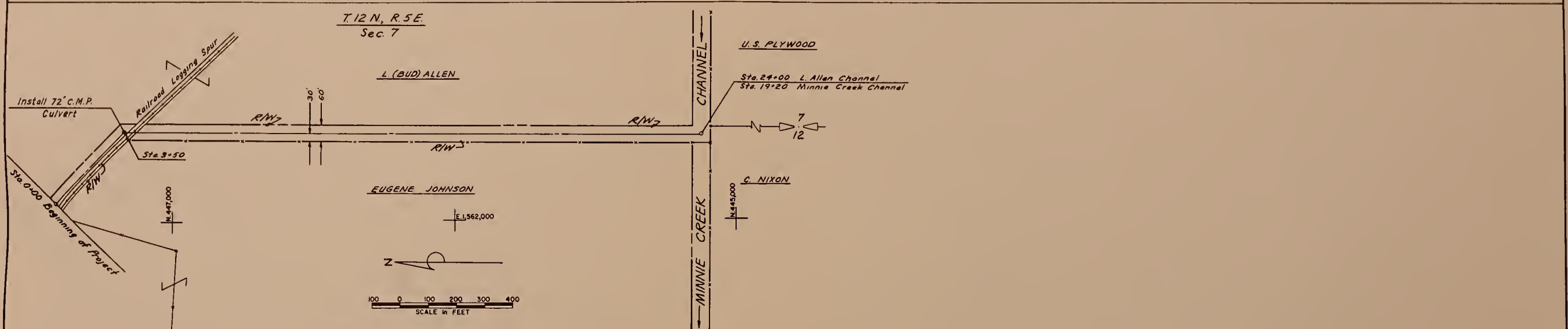
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CHECKED BY J.W.	APPROVED E.L.N.
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PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
BINGAMAN CHANNEL

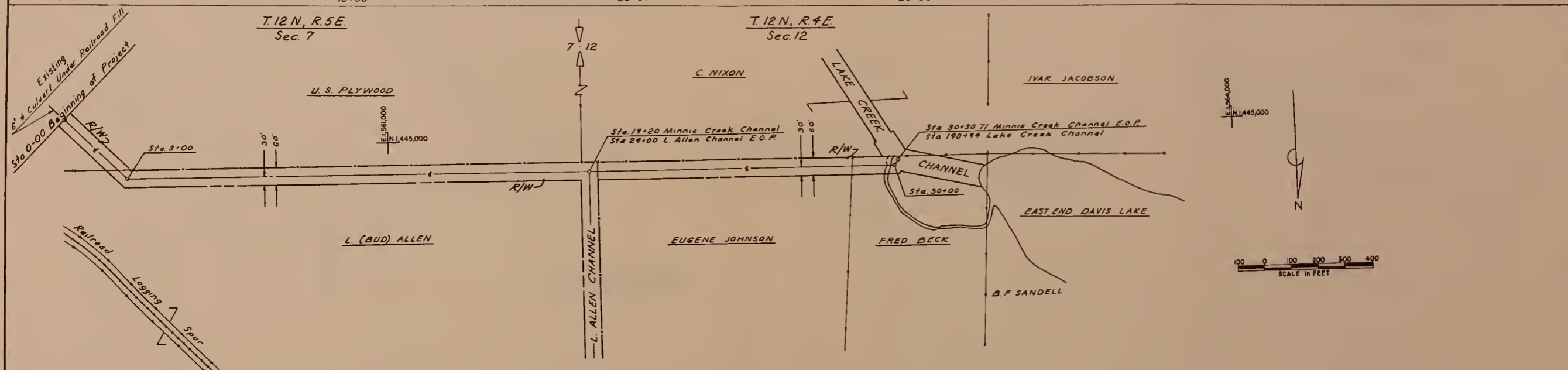
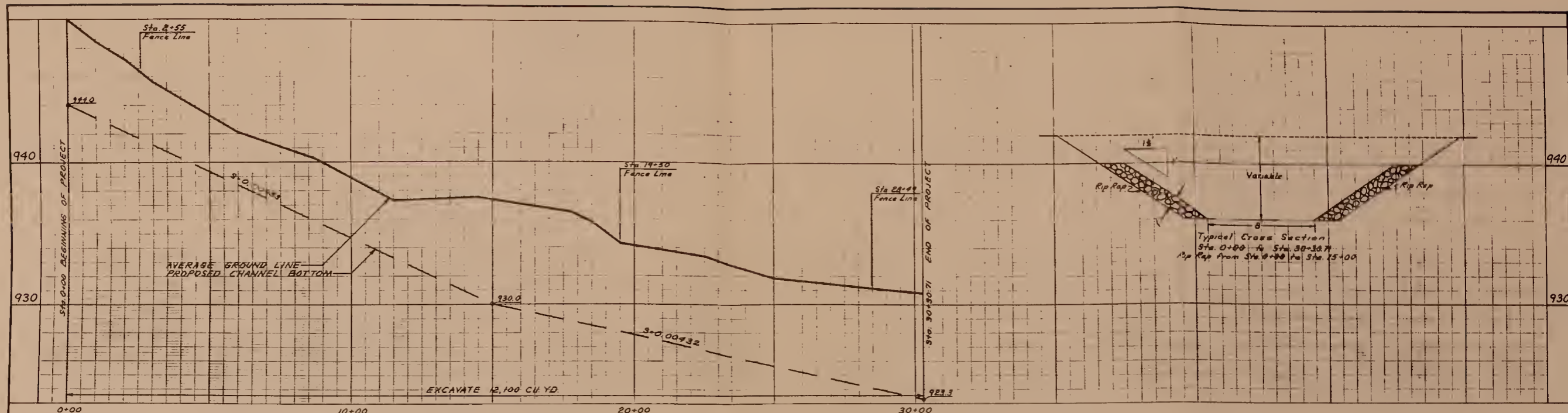
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REVISIONS	DATE	BY
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CHECKED BY: J.W.	DWG. NO. 7-E-20717C	
APPROVED: E.L.N.	SHEET OF SHEET	



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R E V I S I O N S		DATE	BY
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APPROVED: E.L.M.	SHEET OF SHEET		

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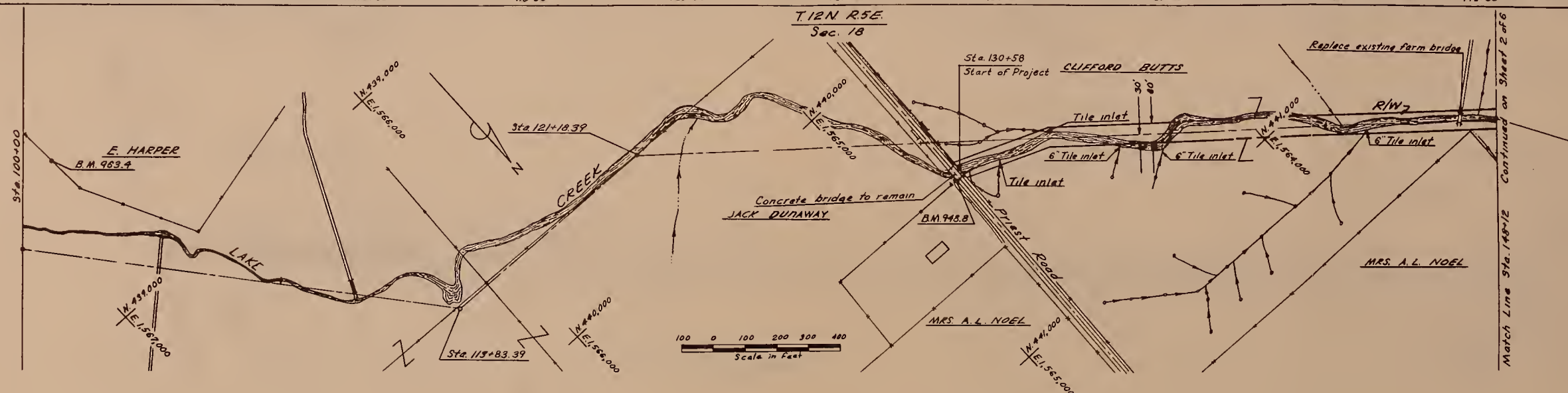
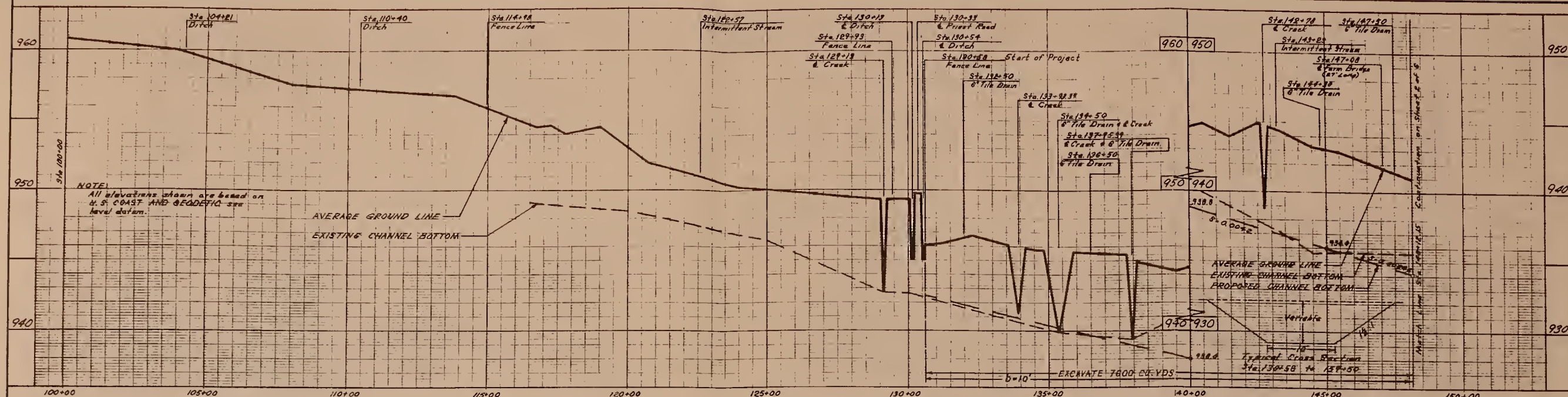
PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
L. ALLEN CHANNEL



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PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
MINNIE CREEK CHANNEL

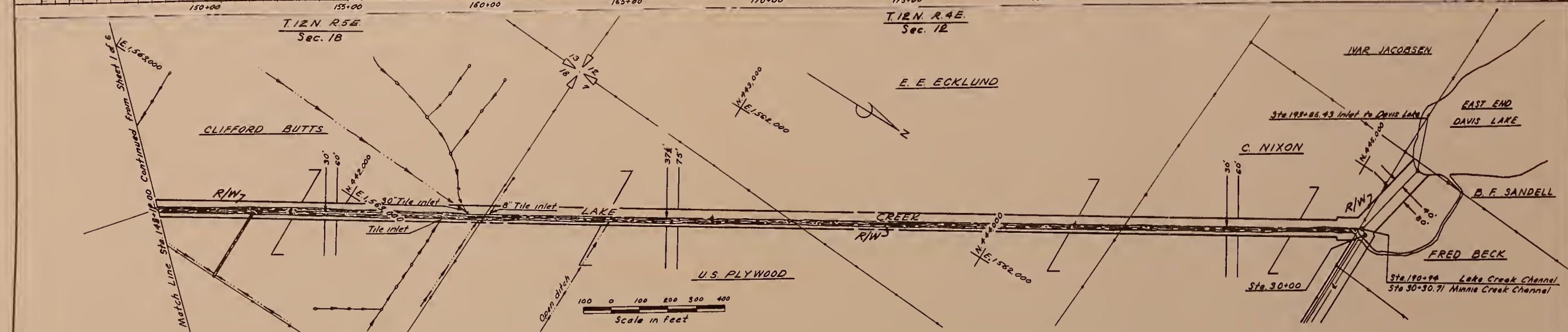
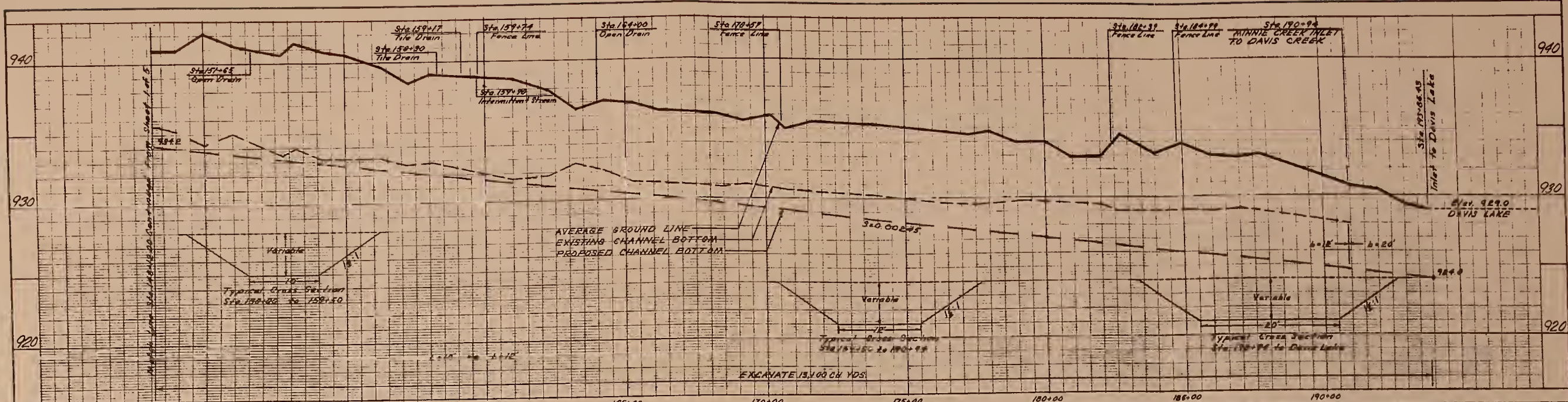
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CHECKED BY: J.W.	DWG. NO. 7-E-20717E
APPROVED: E.L.N., SHEET OF SHEET	



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PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
LAKE CREEK CHANNEL

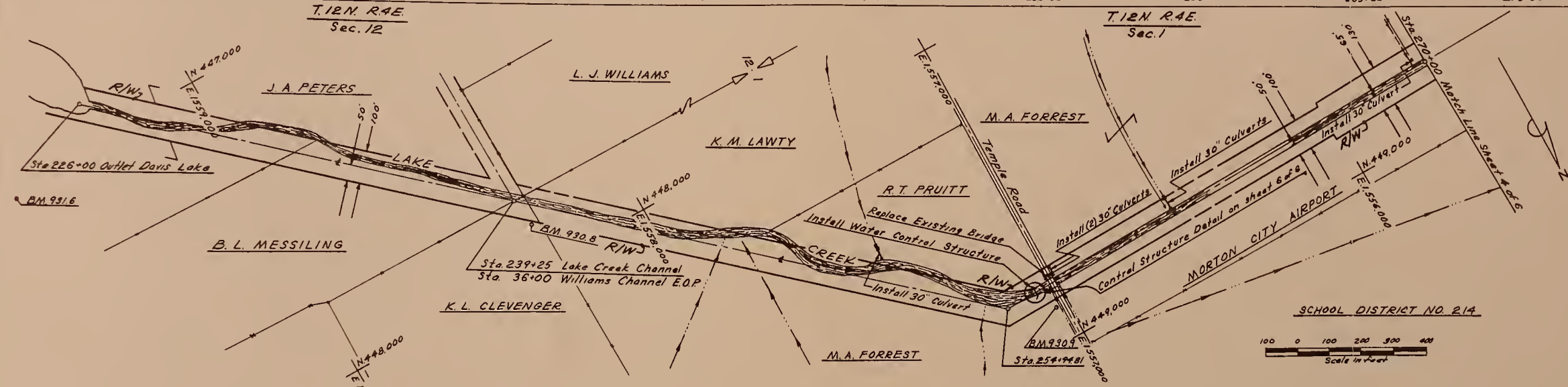
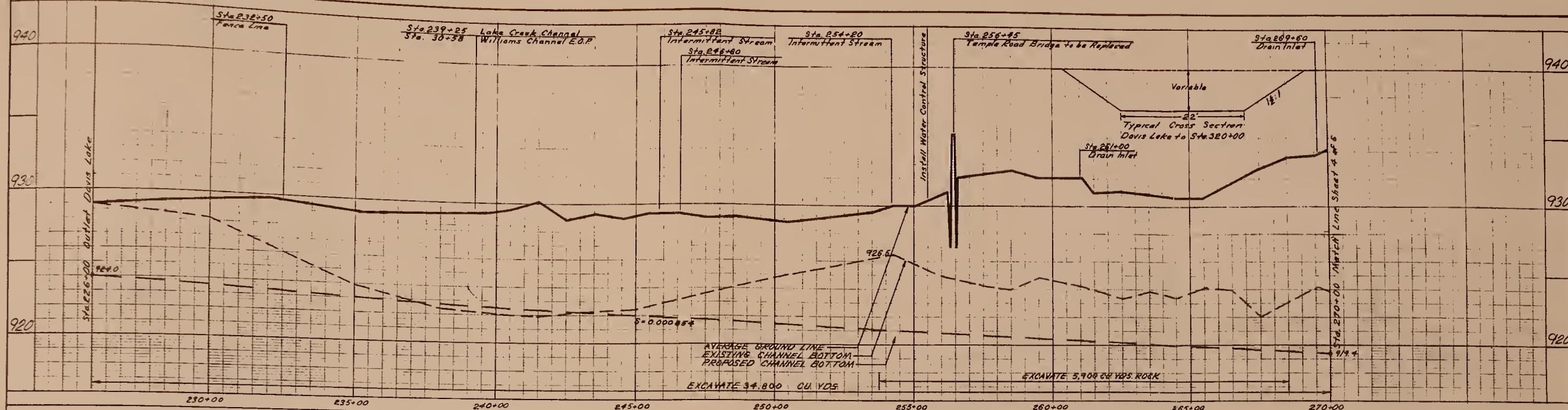
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REVISIONS		DATE BY
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APPROVED: E.L.N.	SHEET OF SHEET	



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PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
LAKE CREEK CHANNEL

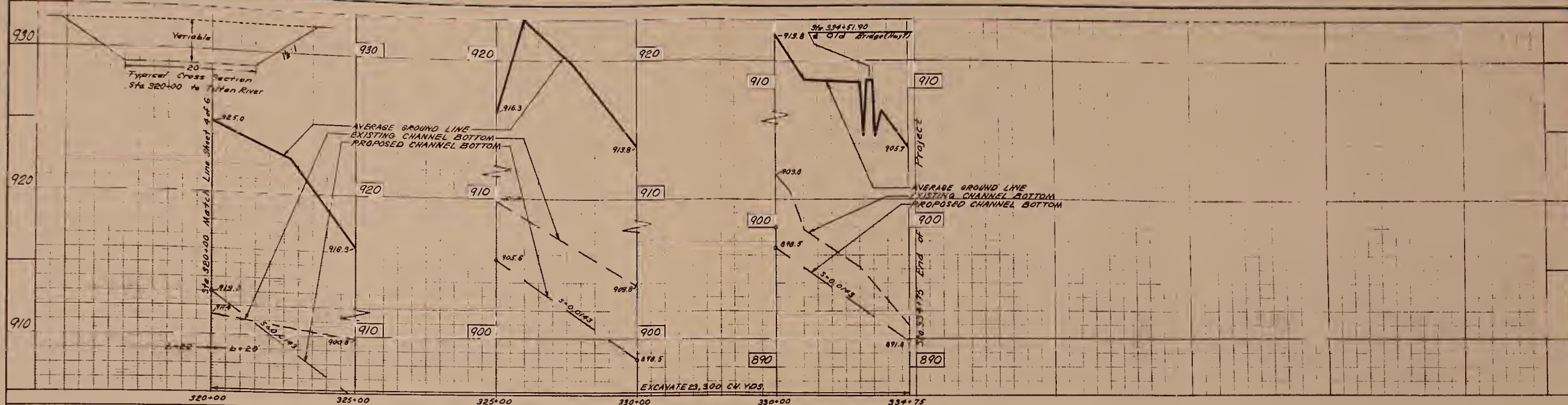
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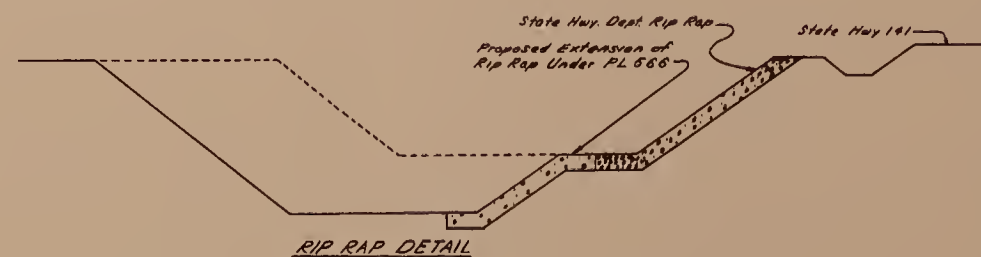
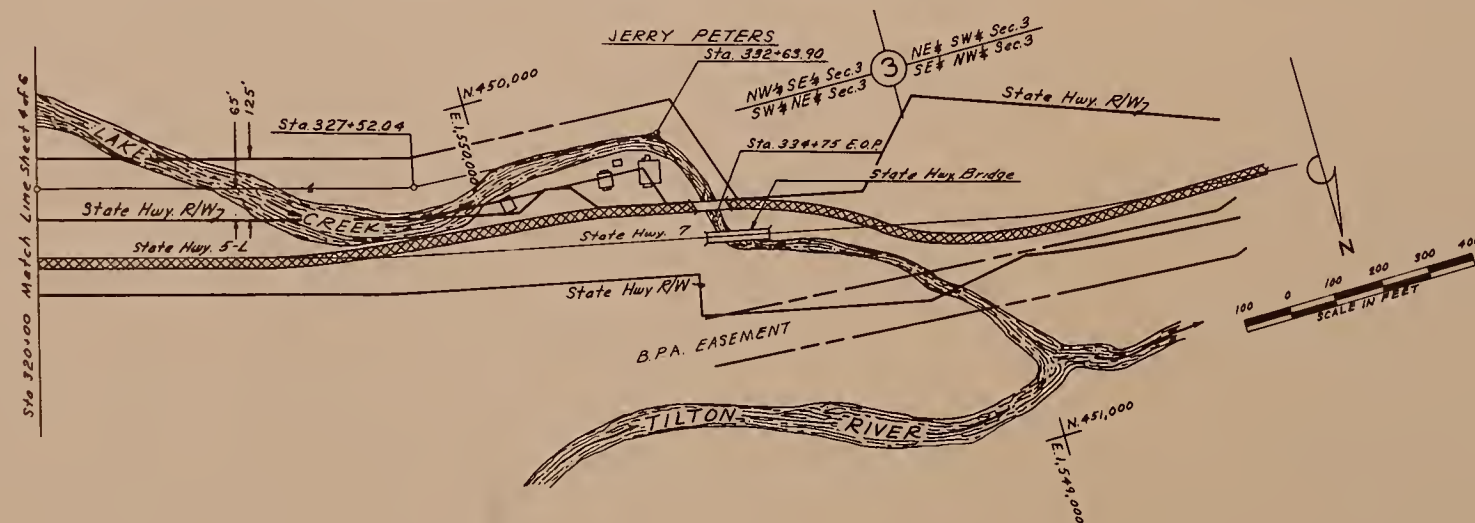
US DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ASSISTING LOCAL SPONSORING AGENCIES

PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
LAKE CREEK CHANNEL

DATE Feb. 10, '67	STA 226+00
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CHECKED BY J.M.	DWG NO 7-E-20717
APPROVED: E.L.N.	SHEET OF SHEET



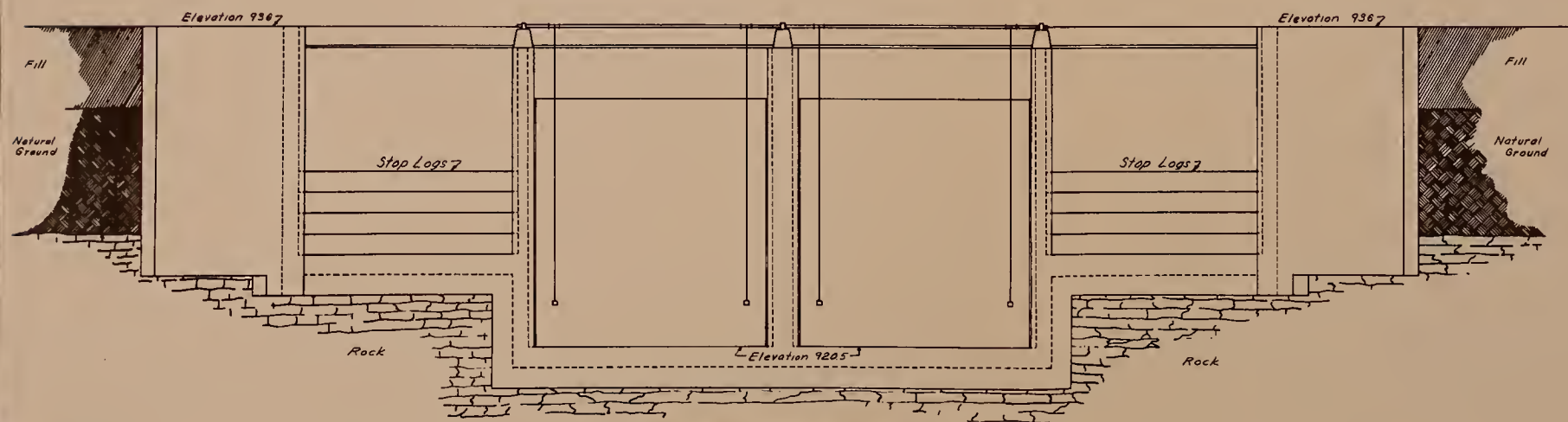
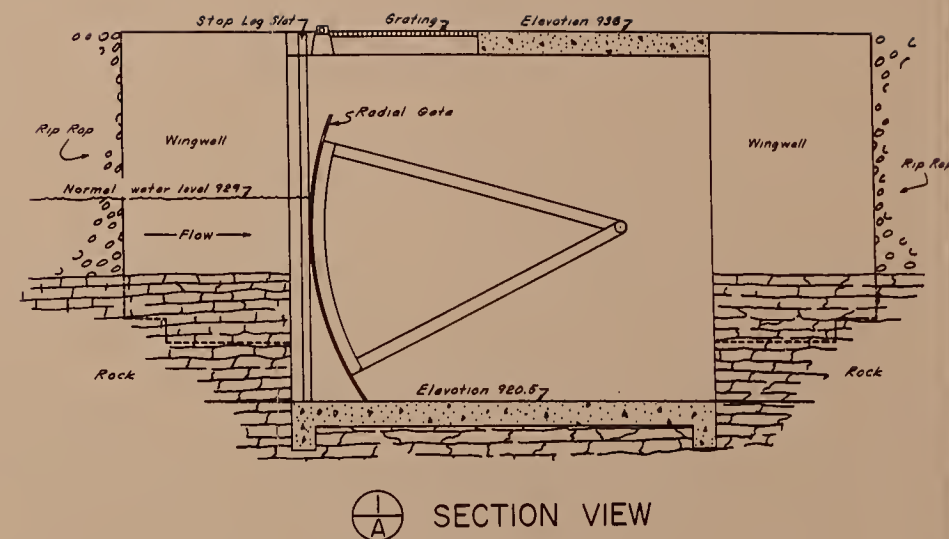
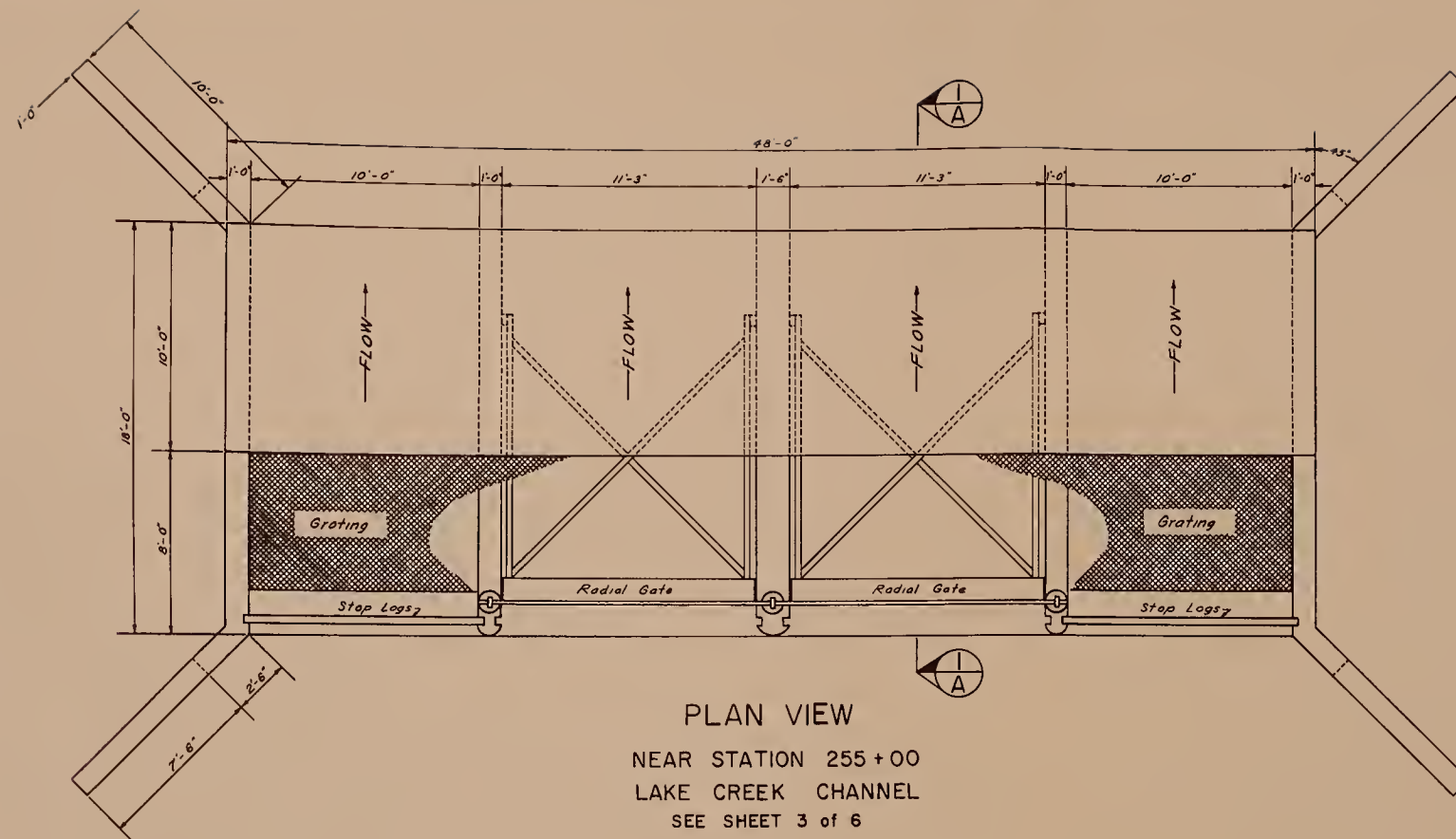
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U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ASSISTING LOCAL SPONSORING AGENCIES

PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
LAKE CREEK CHANNEL

DATE: Feb 21, 67	STA 320+00
DRAWN BY: J.N.B.	STA 334+75
CHECKED BY: J.W.	DWG NO 7-E-20717
APPROVED: E.L.N.	SHEET OF SHEET



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SCALE IN FEET

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ASSISTING LOCAL SPONSORING AGENCIES

PRELIMINARY PLANS
LAKE CREEK WATERSHED, LEWIS COUNTY, WASHINGTON
WATER CONTROL STRUCTURE

ADDED TO TITLE OF PLAN		4-15-67
REVISIONS		DATE BY
DATE	Feb 23, 67	STA
DRAWN BY	J.N.B.	STA
CHECKED BY	J.N.	DWG. NO 7-E-20717
APPROVED	EL.N.	SHEET 6 OF 6

